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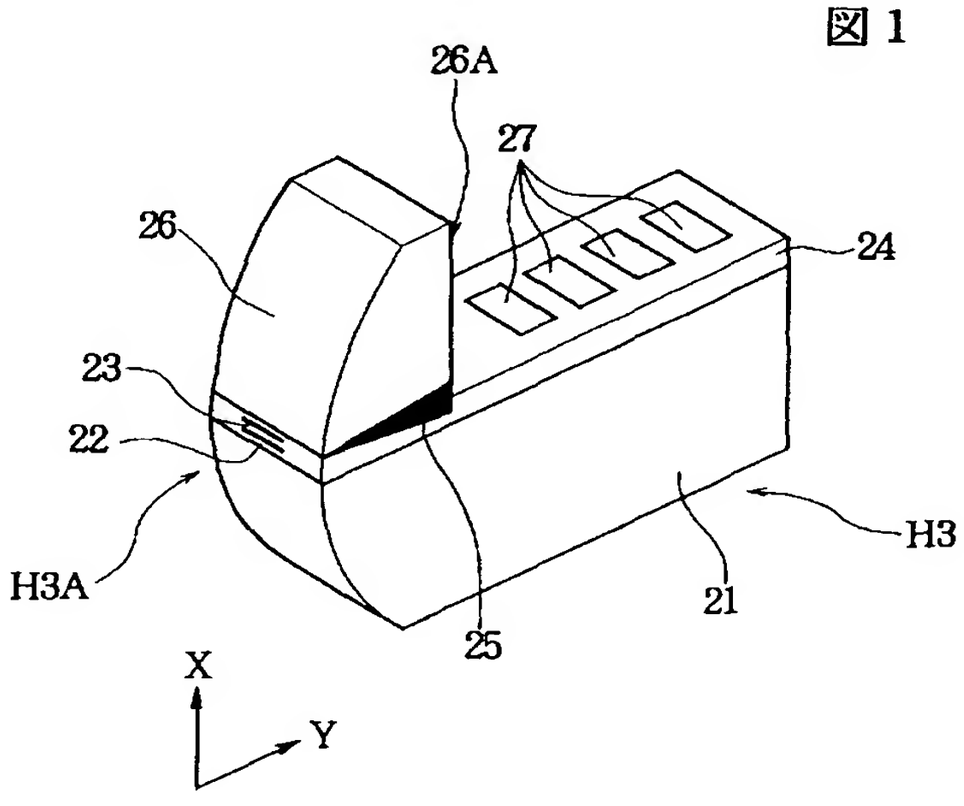
(54)【発明の名称】　摺動型薄膜磁気ヘッドおよびその製造方法

(57)【要約】
【課題】　従来の摺動型薄膜磁気ヘッドでは、薄膜磁気ヘッドを覆う絶縁層と保護基板とを接合する接着層が、テープ対向面に露出しており、磁気テープの磁粉が付着していた。
【解決手段】　接着層２５を、テープ対向面Ｈ３Ａに露出させず、接着層２５のテープ走行方向（Ｘ方向）の厚みを、テープ対向面Ｈ３Ａからハイト方向（Ｙ方向）に向う距離が大きくなるにしたがって厚くさせる。したがって、磁気テープが、テープ対向面Ｈ３Ａを摺動する際に、テープ対向面Ｈ３Ａに磁粉が付着することを防止できる。

図１



【特許請求の範囲】

【請求項１】　磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層、薄膜磁気ヘッド、絶縁性材料からなる保護膜、および磁性材料または非磁性材料によって形成された保護基板を有し、前記薄膜磁気ヘッドの磁気ギャップが、前記磁気ヘッドのテープ対向面に露出されている摺動型薄膜磁気ヘッドにおいて、前記保護膜は接着層を介して前記保護基板と接合されており、この接着層は、前記テープ対向面側よりもハイト方向の奥側の方が厚く形成されていることを特徴とする摺動型薄膜磁気ヘッド。

【請求項２】　磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層、薄膜磁気ヘッド、絶縁性材料からなる保護膜、および磁性材料または非磁性材料によって形成された保護基板を有し、薄膜磁気ヘッドの磁気ギャップが、前記磁気ヘッドのテープ対向面に露出されている摺動型薄膜磁気ヘッドにおいて、前記保護膜は、前記基板上に形成された前記薄膜磁気ヘッド上に薄膜形成された第１の保護膜と、前記保護基板に薄膜形成された第２の保護膜とを有し、前記第１の保護膜と前記第２の保護膜は接着層を介して接合されており、この接着層は、前記テープ対向面側よりもハイト方向の奥側の方が厚く形成されていることを特徴とする摺動型薄膜磁気ヘッド。

【請求項３】　前記接着層は、テープ対向面に現れていない請求項１または２記載の摺動型薄膜磁気ヘッド。

【請求項４】　前記接着層の厚さは、テープ対向面を起点として、ハイト方向に向かって前記保護基板の後端面に至るまで連続的に増加する請求項１ないし３のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項５】　前記薄膜磁気ヘッドが、ＭＲ型薄膜磁気ヘッドである請求項１ないし４のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項６】　前記薄膜磁気ヘッドが、ＭＲ型薄膜磁気ヘッドとインダクティブ磁気ヘッドの複合型薄膜磁気ヘッドである請求項１ないし４のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項７】　前記保護基板が、アルミナチタンカーバイド、チタンカルシウム、カルシウムフェライトなどの非磁性材料によって形成されている請求項１ないし６のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項８】　前記保護膜は、Al_2O_3またはSiO_2によって形成されている請求項１ないし７のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項９】　前記接着層は、エポキシ系接着剤または低融点ガラス系接着剤によって形成されている請求項１ないし８のいずれかに記載の摺動型薄膜磁気ヘッド。

【請求項１０】　（ａ）磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層を薄膜形成する工程と、

（ｂ）前記下地層上に、薄膜磁気ヘッドを薄膜形成する工程と、

（ｃ）前記薄膜磁気ヘッド上に、絶縁性材料からなる保護膜を薄膜形成する工程と、

（ｄ）前記下地層、前記薄膜磁気ヘッド、および保護膜が形成された基板を切断して、スライダバーとする工程と、

（ｅ）前記スライダバーの前記保護膜上に、前記テープ対向面から離れるにしたがって深くなる溝を形成する工程と、

（ｆ）保護基板となる基板を切断してスライダバーとする工程と、

（ｇ）前記スライダバーの一端面を研磨して、傾斜面を形成する工程と、

（ｈ）前記（ｅ）の工程によって保護膜上に溝が形成されたスライダバーと、前記（ｇ）の工程によって傾斜面が形成されたスライダバーとを、前記溝と前記傾斜面を対向させ、接着剤によって接着固定する工程と、を有することを特徴とする摺動型薄膜磁気ヘッドの製造方法。

【請求項１１】　（ｉ）磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層を薄膜形成する工程と、

（ｊ）前記下地層上に、薄膜磁気ヘッドを薄膜形成する工程と、

（ｋ）前記薄膜磁気ヘッド上に、絶縁性材料からなる第１の保護膜を真空成膜法によって薄膜形成する工程と、

（ｌ）前記下地層、前記薄膜磁気ヘッド、および第１の保護膜が形成された基板を切断して、スライダバーとする工程と、

（ｍ）前記スライダバーの前記保護膜上に、前記テープ対向面から離れるにしたがって深くなる溝を形成する工程と、

（ｎ）保護基板となる基板上に、第２の保護膜を真空成膜法によって薄膜形成する工程と、

（ｏ）前記第２の保護膜が形成された基板を切断して、スライダバーとする工程と、

（ｐ）前記第２の保護膜を研磨して、傾斜面を形成する工程と、

（ｑ）前記（ｍ）の工程によって保護膜上に溝が形成されたスライダバーと、前記（ｐ）の工程によって傾斜面が形成されたスライダバーとを、前記溝と前記傾斜面を対向させ、接着剤によって接着固定する工程と、を有することを特徴とする摺動型薄膜磁気ヘッドの製造方法。

【請求項１２】　前記（ｂ）または前記（ｊ）の工程において形成される前記薄膜磁気ヘッドが、ＭＲ型薄膜磁気ヘッドである請求項１０または１１に記載の摺動型薄膜磁気ヘッドの製造方法。

【請求項１３】　前記（ｂ）または前記（ｊ）の工程において形成される前記薄膜磁気ヘッドが、ＭＲ型薄膜磁気ヘッドとインダクティブ磁気ヘッドの複合型薄膜磁気

ヘッドである請求項１０または１１に記載の摺動型薄膜磁気ヘッドの製造方法。

【請求項１４】　前記（ｆ）または前記（ｎ）の工程で用いられる前記保護基板となる基板が、アルミナチタンカーバイド、チタンカルシウム、カルシウムフェライトなどの非磁性材料によって形成されている請求項１０ないし１３のいずれかに記載の摺動型薄膜磁気ヘッドの製造方法。

【請求項１５】　前記（ｃ）、（ｋ）、または（ｎ）の工程において、前記保護膜、あるいは前記第１の保護膜および前記第２の保護膜を、Al_2O_3またはSiO_2によって形成する請求項１０ないし１４のいずれかに記載の摺動型薄膜磁気ヘッドの製造方法。

【請求項１６】　前記（ｈ）または（ｑ）の工程において、前記保護膜と前記保護基板とを、あるいは前記第１の保護膜と前記第２の保護膜とを、エポキシ系接着剤または低融点ガラス系接着剤によって接着する請求項１０ないし１５のいずれかに記載の摺動型薄膜磁気ヘッドの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、磁気テープに記録信号を記録し、再生する映像機器の磁気記録再生装置、またはコンピュータ用のデータ磁気記録再生装置などを構成する摺動型薄膜磁気ヘッドに係り、特に磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、前記テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることのできる摺動型薄膜磁気ヘッドおよびその製造方法に関する。

【０００２】

【従来の技術】映像機器での磁気記録装置、またはコンピュータ用のデータを保存する磁気記録再生装置などでは、回転ヘッド装置の回転ドラムに磁気ヘッドが搭載され、磁気テープが前記回転ドラムにヘリカル軌跡で接触して走行するとともに前記回転ドラムが回転して、磁気テープに対してヘリカルスキャン方式で記録動作が行なわれる。

【０００３】図１４は従来の磁気ヘッドの一例を示す斜視図、図１５は前記磁気ヘッドが搭載された磁気記録再生装置の回転ヘッド装置を示す平面図である。

【０００４】図１４に示すように、磁気ヘッドＨ１は、フェライトなどの高透磁率の磁性材料で形成されたコア１と２を有しており、磁気テープＴとの摺動面において、コア１と２との対向部に磁性材料層が介装されて磁気ギャップＧが形成されている。前記コア１，２には記録・再生用のコイル３，４が巻かれている。またテープ対向面Ｈ１Ａにおいてコア１と２の両側部にはＶ字状のギャップ規制溝５，５が形成され、磁気ギャップＧのトラック幅Ｔｗが規定されている。なお、このギャップ規制溝５，５内には耐磨耗性の非磁性材料例えば接合ガラス、SiO_2などが充填されている。

【０００５】図１５に示す磁気記録再生装置に設けられる回転ヘッド装置１０では、固定ドラム（図示せず）が固定され、前記固定ドラム上に、これと同軸の回転ドラム１０ａが回転自在に支持され、モータの動力により回転ドラム１０ａが矢印方向へ回転駆動される。磁気記録媒体である磁気テープＴは、回転ヘッド装置１０にヘリカル軌跡にて所定角度巻付けられて矢印方向へ走行する。この間、回転ドラム１０ａが回転し、この回転ドラム１０ａに搭載された磁気ヘッドＨ１が磁気テープＴを走査する。図１５の回転ヘッド装置では、１組の磁気ヘッドＨ１，Ｈ１が互いに対向する位置に設けられている。

【０００６】図１４に示された磁気ヘッドＨ１では、コア１とコア２との対向部が研削加工されることにより、磁気ギャップＧが所定のトラック幅Ｔｗで形成されている。

【０００７】近年、映像機器の磁気記録再生装置やコンピュータ用のデータ磁気記録再生装置などにおいて、磁気記録媒体への高記録密度化を実現するためによりトラック幅を狭くする狭トラック化や高周波化が図られている。

【０００８】狭トラック化のためには、磁気ギャップのトラック幅Ｔｗを小さくする必要がある。また、狭トラック化を進めるにつれて、磁気ギャップの加工精度を向上させる必要がある。特に、最近では、トラック幅Ｔｗが１０μｍ以下のフォーマットも提案されるようになってきている。しかし、図１４に示された磁気ヘッドＨ１では、磁気ギャップＧを研削加工によって形成しているため、狭トラック化を進めていくにつれて、加工精度を向上させることが困難になってきた。

【０００９】そこで、狭トラック化に対応するために、薄膜形成プロセスによって形成される薄膜磁気ヘッドを用いることが提案されている。

【００１０】図１６は摺動型薄膜磁気ヘッドの斜視図である。この摺動型薄膜磁気ヘッドＨ２は、アルミナチタンカーバイドからなる基板１１上に、再生用のＭＲ型薄膜磁気ヘッド１２、記録用のインダクティブヘッド１３、および保護膜である絶縁層１４が薄膜形成プロセスによって形成され、さらに、絶縁層１４上に、エポキシ系接着剤１５によって、アルミナチタンカーバイドからなる保護基板１６が接着されている。

【００１１】ＭＲ型薄膜磁気ヘッド１２の磁気ギャップおよびインダクティブヘッド１３の磁気ギャップは、摺動型薄膜磁気ヘッドのテープ対向面Ｈ２Ａに露出している。ＭＲ型薄膜磁気ヘッド１２とインダクティブヘッド１３に流される電流は、電極１７を通じて与えられる。

【００１２】

【発明が解決しようとする課題】図１７は、図１６の摺動型薄膜磁気ヘッドＨ２のＭＲ型薄膜磁気ヘッド１２お

よびインダクティブヘッド１３周辺の拡大部分断面図である。

【００１３】再生用のＭＲ型薄膜磁気ヘッド１２は、アルミナチタンカーバイドからなる基板１１に、下地層である絶縁層１２ａを介して、下部シールド層１２ｂ、下部ギャップ層１２ｃ、ＭＲ素子層１２ｄ、電極層１２ｅ、上部ギャップ層１２ｆおよび、上部シールド層１２ｇが積層されて形成されている。下部シールド層１２ｂと上部シールド層１２ｇに挟まれた磁気テープに対向する部分がＭＲ型薄膜磁気ヘッド１２の磁気ギャップＧ１となる。

【００１４】再生用のＭＲ型薄膜磁気ヘッド１２の上に設けられる記録用のインダクティブヘッド１３は、上部シールド層と兼用の下部コア層１３ａ上に、ギャップ層１３ｂ、コイル層１３ｃ、絶縁層１３ｄ、および上部コア層１３ｅが積層されて形成されている。下部コア層１３ａと上部コア層１３ｅに挟まれた磁気テープに対向する部分がインダクティブヘッド１３の磁気ギャップＧ２となる。

【００１５】さらに、インダクティブヘッド１３上に絶縁層１４が積層され、絶縁層１４上に、エポキシ樹脂系接着剤からなる接着層１５を介して、アルミナチタンカーバイドからなる保護基板１６が接合されている。

【００１６】図１６および図１７に示された摺動型薄膜磁気ヘッドでは、接着層１５の厚さが、接着層１５がテープ対向面Ｈ２Ａに露出している面から保護基板１６の後端面１６Ａ側に露出している面に至るまで一定の厚さσ１である。したがって、接着層１５は、テープ対向面Ｈ２Ａに、厚さσ１で露出している。

【００１７】接着層１５が、テープ対向面Ｈ２Ａに、このような厚さσ１で露出していると、磁気テープがテープ対向面Ｈ２Ａを摺動するときに、磁気テープから磁粉が剥がれて、接着層１５の露出面１５Ａに付着するという問題が生じていた。

【００１８】磁気テープから磁粉が剥がれると、磁粉が剥がれた分だけ、磁気テープの磁気特性が低下する。また、磁粉が、接着層１５の露出面１５Ａに付着している状態で、磁気テープが、接着層１５の露出面１５Ａを摺動すると、磁気テープの任意の部位に、磁粉が再付着してしまうことがある。磁粉が、磁気テープの任意の部位に再付着することが生じると、磁気テープ上に、信号を正確に記録できなくなったり、本来記録されていた信号が正確に再生できなくなる。

【００１９】本発明は、上記従来の課題を解決するためのものであり、磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、前記テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることのできる摺動型薄膜磁気ヘッドおよびその製造方法を提供することを目的とする。

【００２０】

【課題を解決するための手段】本発明は、磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層、薄膜磁気ヘッド、絶縁性材料からなる保護膜、および磁性材料または非磁性材料によって形成された保護基板を有し、前記薄膜磁気ヘッドの磁気ギャップが、前記磁気ヘッドのテープ対向面に露出されている摺動型薄膜磁気ヘッドにおいて、前記保護膜は接着層を介して前記保護基板と接合されており、この接着層は、前記テープ対向面側よりもハイト方向の奥側の方が厚く形成されていることを特徴とするものである。

【００２１】本発明の摺動型薄膜磁気ヘッドでは、前記保護膜と前記保護基板を接合する接着層の厚さは、前記接着層が前記テープ対向面からハイト方向（Ｙ方向）に向って離れるにしたがって厚くなっている。

【００２２】したがって、保護層と保護基板との接着力を十分に確保でき、しかも磁気ヘッドのテープ対向面に露出する接着層の面積を最小にできるため、前記テープ対向面に多くの磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることができる。

【００２３】また本発明は、磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層、薄膜磁気ヘッド、絶縁性材料からなる保護膜、および磁性材料または非磁性材料によって形成された保護基板を有し、薄膜磁気ヘッドの磁気ギャップが、前記磁気ヘッドのテープ対向面に露出されている摺動型薄膜磁気ヘッドにおいて、前記保護膜は、前記基板上に形成された前記薄膜磁気ヘッド上に薄膜形成された第１の保護膜と、前記保護基板に薄膜形成された第２の保護膜とを有し、前記第１の保護膜と前記第２の保護膜は接着層を介して接合されており、この接着層は、前記テープ対向面側よりもハイト方向の奥側の方が厚く形成されていることを特徴とするものである。

【００２４】前記接着層が、前記保護基板と直接接合されていると、磁気テープが前記テープ対向面を摺動するときに、前記保護基板が前記接着層との界面において、損傷することがある。特に前記保護基板がアルミナチタンカーバイドなどの様に、結晶粒の脱粒が生じ易い材料によって形成されている場合に、前記保護基板が前記接着層との界面において、脱粒しやすい。前記接着層と前記保護基板の接合力は、主に接着剤を構成する分子と前記保護基板を構成する分子間に分子間力（ファン・デル・ワールス力）が働くことによって発生するものであるので、充分な接合強度を得られないためである。

【００２５】そこで、前記保護基板の前記接着層に対向する面に、例えばスパッタ法などで、絶縁性材料からなる第２の保護膜を薄膜形成しておき、前記接着層が、この第２の保護膜と接合されるようにする。

【００２６】スパッタ法では、一定の水準以上のエネルギー、例えば、１０ｅＶ以上のエネルギーをもった前記第２の保護膜の材料原子が、前記保護基板上に打ち込ま

れる。このとき、前記第２の保護膜の材料原子と前記保護基板の構成原子とを共有結合させることができる。したがって、前記保護基板と前記第２の保護膜の接合力が強力になるので、保護基板が前記接着層との界面において、損傷することが避けられる。

【００２７】そしてこのように保護層の間に形成されている接着層がテープ対向面に露出する面積を最小にすることにより、磁粉の付着を抑制できる。

【００２８】また、前記接着層は、テープ対向面に現れていないことが好ましい。ただし、接着層がテープ対向面にわずかに露出する場合も有り得る。

【００２９】また、前記接着層の厚さは、テープ対向面を起点として、ハイト方向に向かって前記保護基板の後端面に至るまで連続的に増加していることが好ましい。

【００３０】ただし、前記接着層の厚さが、ハイト方向へ段階的に厚くなっていてもよいし、あるいは接着層の厚さがハイト方向へ向けて一旦厚くなり、その後にハイト方向へ向けて薄くなるものでもよい。

【００３１】なお、前記薄膜磁気ヘッドとして、再生用のＭＲ型薄膜磁気ヘッドのみを形成してもよいし、再生用のＭＲ型薄膜磁気ヘッドの上層に、記録用のインダクティブ磁気ヘッドが積層された複合型薄膜磁気ヘッドを形成してもよい。

【００３２】再生用のＭＲ型薄膜磁気ヘッドの上層に、記録用のインダクティブヘッドが積層された複合型薄膜磁気ヘッドであれば、一つの磁気ヘッドによって、記録および再生を行うことができる。また、前記インダクティブヘッドは、レジストフォトリソグラフィーなどの薄膜形成プロセスによって形成されるので、磁気ギャップの加工精度を向上させることが容易であり、狭トラック化が容易になる。ただし、インダクティブヘッドが発生させる磁界の強さは、従来、磁気テープに信号を記録するためによく用いられてきた、磁性材料のコアと、このコアに巻かれた銅線等からなるバルク型磁気ヘッドが発生させる磁界の強さよりも弱い。したがって、インダクティブヘッドを、磁気テープに記録信号を記録するための磁気ヘッドとして用いる場合には、磁気テープのテープ厚を薄くするなどして、磁気テープ側の記録感度を高める必要がある。

【００３３】前記保護基板を形成する非磁性材料には、例えば、アルミナチタンカーバイド、チタンカルシウム、カルシウムフェライトなどがある。

【００３４】前記保護基板は、摺動型薄膜磁気ヘッドのテープ対向面上を磁気テープが走行するときに、ＭＲ型薄膜磁気ヘッドやインダクティブヘッドが過剰に摩耗することや、破損することを防止する目的で形成されている。

【００３５】上述した非磁性材料は、硬い材質であるので、前記保護基板を形成する材料として適している。

【００３６】また、前記第１の保護膜および前記第２の保護膜を形成する絶縁性材料には、例えば、Al_2O_3またはSiO_2がある。

【００３７】また、前記接着層は、エポキシ系接着剤または低融点ガラス系接着剤によって形成されていることが好ましい。

【００３８】図８に示されるような、従来の磁気ヘッドの製造には、高融点ガラス系接着剤が用いられてきた。しかし、高融点ガラス系接着剤は、接合時に約８００℃の温度で加熱することが必要になる。ところが、８００℃もの高温に曝されると、本発明を構成するＭＲ型薄膜磁気ヘッドの特性が劣化してしまう。ＭＲ型薄膜磁気ヘッドが耐えられる温度は、だいたい、３００℃程度までである。したがって、本発明においては、接着工程を３００℃以下で行うことのできるエポキシ系接着剤または低融点ガラス系接着剤によって、前記接着層が形成されていることが好ましい。

【００３９】また、本発明の摺動型薄膜磁気ヘッドの製造方法は、（ａ）磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層を薄膜形成する工程と、（ｂ）前記下地層上に、薄膜磁気ヘッドを薄膜形成する工程と、（ｃ）前記薄膜磁気ヘッド上に、絶縁性材料からなる保護膜を薄膜形成する工程と、（ｄ）前記下地層、前記薄膜磁気ヘッド、および保護膜が形成された基板を切断して、スライダバーとする工程と、（ｅ）前記スライダバーの前記保護膜上に、前記テープ対向面から離れるにしたがって深くなる溝を形成する工程と、（ｆ）前記保護基板となる基板を切断してスライダバーとする工程と、（ｇ）前記スライダバーの一端面を研磨して、傾斜面を形成する工程と、（ｈ）前記（ｅ）の工程によって、保護膜上に溝が形成されたスライダバーと、前記（ｇ）の工程によって、傾斜面が形成されたスライダバーとを、前記溝と前記傾斜面を対向させ、接着剤によって接着固定する工程と、を有することを特徴とするものである。

【００４０】上述の製造方法を用いることにより、前記接着剤からなる接着層が、前記テープ対向面からハイト方向（Ｙ方向）に向うにしたがって厚くなっている摺動型薄膜磁気ヘッドを形成することができる。

【００４１】つまり、磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、前記テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることのできる摺動型薄膜磁気ヘッドを形成することができる。

【００４２】または、本発明の摺動型薄膜磁気ヘッドの製造方法は、（ｉ）磁性材料または非磁性材料によって形成された基板上に、絶縁性材料からなる下地層を薄膜形成する工程と、（ｊ）前記下地層上に、薄膜磁気ヘッドを薄膜形成する工程と、（ｋ）前記薄膜磁気ヘッド上に、絶縁性材料からなる第１の保護膜を真空成膜法によって薄膜形成する工程と、（ｌ）前記下地層、前記薄膜

磁気ヘッド、および前記第１の保護膜が形成された基板を切断して、スライダバーとする工程と、（m）前記スライダバーの前記保護膜上に、前記テープ対向面から離れるにしたがって深くなる溝を形成する工程と、（n）前記保護基板となる基板上に、第２の保護膜を真空成膜法によって薄膜形成する工程と、（o）前記第２の保護膜が形成された基板を切断して、スライダバーとする工程と、（p）前記第２の保護膜を研磨して、傾斜面を形成する工程と、（q）前記（m）の工程によって、保護膜上に溝が形成されたスライダバーと、前記（p）の工程によって、前記傾斜面が形成されたスライダバーとを、前記溝と前記傾斜面を対向させ、接着剤によって接着固定する工程とを有することを特徴とするものである。

【００４３】本発明では、前記（n）の工程において、前記保護基板上に、例えばスパッタ法などで、絶縁性材料からなる第２の保護膜を薄膜形成している。

【００４４】スパッタ法では、一定の水準以上のエネルギー、例えば、１０ｅＶ以上のエネルギーをもった前記第２の保護膜の材料原子が、前記保護基板上に打ち込まれる。このとき、前記第２の保護膜の材料原子と前記保護基板の構成原子とを共有結合させることができる。したがって、前記保護基板と前記第２の保護膜の接合力が強力になるので、前記テープ対向面上を、磁気テープが摺動するときに、前記保護基板が、前記第２の保護膜との界面において、損傷することが避けられる。

【００４５】なお、前記（b）または前記（j）の工程において形成される前記薄膜磁気ヘッドとして、再生用のＭＲ型薄膜磁気ヘッドのみを形成してもよいし、再生用のＭＲ型薄膜磁気ヘッドの上層に、記録用のインダクティブ磁気ヘッドが積層された複合型薄膜磁気ヘッドを形成してもよい。

【００４６】また、前記（f）または前記（n）の工程で用いられる前記保護基板となる基板は、例えば、アルミナチタンカーバイド、チタンカルシウム、カルシウムフェライトなど、硬い材質の非磁性材料によって形成されていることが好ましい。

【００４７】また、前記（c）、（k）、または（n）の工程において、前記保護膜、あるいは前記第１の保護膜および前記第２の保護膜は、Al_2O_3またはSiO_2によって形成することができる。

【００４８】さらに、前記（h）または（q）の工程において、前記保護膜と前記保護基板とを、あるいは前記第１の保護膜と前記第２の保護膜とを、ＭＲ型薄膜磁気ヘッドの特性が劣化しない３００℃以下の温度で接着工程を行うことができるエポキシ系接着剤または低融点ガラス系接着剤によって接着することが好ましい。

【００４９】

【発明の実施の形態】図１は、本発明の実施の形態を示す摺動型薄膜磁気ヘッドの斜視図である。

【００５０】この摺動型薄膜磁気ヘッドＨ３は、アルミナチタンカーバイドからなる基板２１上に、Al_2O_3やSiO_2などの絶縁性材料からなる下地層を介して、再生用のＭＲ型薄膜磁気ヘッド２２、記録用のインダクティブヘッド２３、および保護膜であるAl_2O_3からなる絶縁層２４が薄膜形成プロセスによって形成され、絶縁層２４上にエポキシ系接着剤からなる接着層２５を介して、アルミナチタンカーバイドからなる保護基板２６が接合されることによって形成されている。

【００５１】接着層２５は、テープ対向面Ｈ３Ａに露出されていない。あるいは露出していてもその露出面積はわずかである。また、接着層２５のテープ走行方向（Ｘ方向）の厚みが、テープ対向面Ｈ３Ａからハイト方向（Ｙ方向）に向う距離が大きくなるにしたがって厚くなっている。したがって、この摺動型薄膜磁気ヘッドＨ３では、絶縁層２４と保護基板２６との接着が、主にテープ対向面Ｈ３Ａよりもハイト側に離れた部位においてなされている。

【００５２】したがって、磁気テープが、テープ対向面Ｈ３Ａを摺動する際に、テープ対向面Ｈ３Ａに磁粉が付着することを防止でき、あるいは抑制でき、磁気テープの磁気記録特性を向上させることができる。

【００５３】また、本実施の形態の摺動型薄膜磁気ヘッドＨ３では、絶縁層２４の接着層２５との接合面、および保護基板２６の接着層２５との接合面が、テープ走行方向（Ｘ方向）に垂直な平面に対する傾斜面とされている。すなわち、接着層２５のテープ走行方向の厚さが、テープ対向面Ｈ３Ａを起点として、ハイト方向（Ｙ方向）に向かって保護基板２６の後端面２６Ａに至るまで連続的に増加するようにされている。

【００５４】ＭＲ型薄膜磁気ヘッド２２の磁気ギャップおよびインダクティブヘッド２３の磁気ギャップは、摺動型薄膜磁気ヘッドＨ３のテープ対向面Ｈ３Ａに露出されている。ＭＲ型薄膜磁気ヘッド２２とインダクティブヘッド２３に流される電流は、電極２７を通じて与えられる。

【００５５】図２は、図１の摺動型薄膜磁気ヘッドＨ３のＭＲ型薄膜磁気ヘッド２２およびインダクティブヘッド２３周辺の部分断面図である。

【００５６】再生用のＭＲ型薄膜磁気ヘッド２２は、薄膜形成プロセスによって、アルミナチタンカーバイドからなる基板２１に、下地層である絶縁層２２ａを介して、下部シールド層２２ｂ、下部ギャップ層２２ｃ、ＭＲ素子層２２ｄ、ハードバイアス層（図示せず）、電極層２２ｅ、上部ギャップ層２２ｆおよび、上部シールド層２２ｇが積層されて形成されている。下部シールド層２２ｂと上部シールド層２２ｇに挟まれた磁気テープに対向する部分がＭＲ型薄膜磁気ヘッド２２の磁気ギャップＧ３となる。

【００５７】ＭＲ型薄膜磁気ヘッド２２上に設けられる

記録用のインダクティブヘッド２３は、ＭＲ型薄膜磁気ヘッド２２と同様に薄膜形成プロセスによって、上部シールド層と兼用の下部コア層２３ａ上に、ギャップ層２３ｂ、コイル層２３ｃ、絶縁層２３ｄ、および上部コア層２３ｅが積層されて形成されている。下部コア層２３ａと上部コア層２３ｅに挟まれた磁気テープに対向する部分がインダクティブヘッド２３の磁気ギャップＧ４となる。

【００５８】絶縁層２２ａ、下部ギャップ層２２ｃ、上部ギャップ層２２ｆ、ギャップ層２３ｂは、Al_2O_3またはSiO_2によって形成されている。また、下部シールド層２２ｂ、上部シールド層２２ｇ（下部コア層２３ａ）、上部コア層２３ｅは、パーマロイなどの軟磁性材料によって形成されている。電極層２２ｅ、コイル層２３ｃは、Ｃｕなどの導電性材料によって形成されている。ハードバイアス層は、ＰｔＣｏなどの硬磁性材料によって形成されている。絶縁層２３ｄはレジストによって形成されている。

【００５９】また、インダクティブヘッド２３上に、保護膜である絶縁層２４が積層され、絶縁層２４と保護基板２６とが、エポキシ系接着剤からなる接着層２５を介して接合されている。

【００６０】接着層２５のテープ対向面Ｈ３Ａにおけるテープ走行方向（Ｘ方向）の厚みは、テープ対向面Ｈ３Ａにおいて０であり、テープ対向面Ｈ３Ａからハイト方向（Ｙ方向）に向う距離が大きくなるにしたがって厚くなっている。

【００６１】なお、本実施の形態では、絶縁層２４の接着層２５との接合面、および保護基板２６の接着層２５との接合面の面積が、図１６に示された従来の摺動型薄膜磁気ヘッドの絶縁層１４の接着層１５との接合面、および保護基板１６の接着層１５との接合面の面積より狭くなることはない。

【００６２】したがって、接着層２５を介した、絶縁層２４と保護基板２６との接合力が、従来の摺動型薄膜磁気ヘッドと比べて、低下することはない。

【００６３】なお、本実施の形態では、絶縁層２４の接着層２５との接合面、および保護基板２６の接着層２５との接合面が、テープ走行方向に垂直な平面に対する傾斜面とされているが、どちらか一方の接合面のみが傾斜面とされていてもよい。

【００６４】本実施の形態の摺動型薄膜磁気ヘッドＨ３は、図３に示す磁気記録再生装置に設けられる回転ヘッド装置４０を構成するために用いることができる。

【００６５】回転ヘッド装置４０では、固定ドラム（図示せず）が固定され、前記固定ドラム上に、これと同軸の回転ドラム４０ａが回転自在に支持され、モータの動力により回転ドラム４０ａが矢印方向へ回転駆動される。磁気記録媒体である磁気テープＴは、回転ヘッド装置４０にヘリカル軌跡にて所定角度巻付けられて矢印方向へ走行する。この間、回転ドラム４０ａが回転し、この回転ドラム４０ａに搭載された磁気ヘッドＨ３が磁気テープＴを走査する。図３の回転ヘッド装置では、１組の磁気ヘッドＨ３，Ｈ３が互いに対向する位置に設けられている。

【００６６】なお、磁気ヘッドＨ３は、回転ドラム４０ａに３個以上搭載されてもよい。

【００６７】図４は、本発明の他の実施の形態を示す摺動型薄膜磁気ヘッドの斜視図である。図４では、アルミナチタンカーバイドからなる基板３１上に、Al_2O_3やSiO_2などの絶縁性材料からなる下地層を介して、再生用のＭＲ型薄膜磁気ヘッド３２、記録用のインダクティブヘッド３３、および第１の保護膜であるAl_2O_3からなる絶縁層３４が薄膜形成プロセスによって形成されている。一方、アルミナチタンカーバイドからなる保護基板３５の絶縁層３４に対向する面には、第２の保護膜である絶縁層３６が、スパッタ法などの真空成膜法によって薄膜形成されている。

【００６８】絶縁層３４と絶縁層３６とが、エポキシ系接着剤からなる接着層３７を介して接合されることにより、摺動型薄膜磁気ヘッドＨ４が形成されている。

【００６９】接着層３７は、テープ対向面Ｈ４Ａに露出されていない。あるいは露出面積がわずかである。また、接着層３７のテープ走行方向（Ｘ方向）の厚みが、テープ対向面Ｈ４Ａからハイト方向（Ｙ方向）に向う距離が大きくなるにしたがって厚くなっている。

【００７０】したがって、磁気テープが、テープ対向面Ｈ４Ａを摺動する際に、テープ対向面Ｈ４Ａに磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることができる。

【００７１】また、本実施の形態の摺動型薄膜磁気ヘッドＨ４でも、接着層３７のテープ走行方向の厚さが、テープ対向面Ｈ４Ａを起点として、ハイト方向（Ｙ方向）に向かって保護基板３５の後端面３５Ａに至るまで連続的に増加するようにされている。

【００７２】ＭＲ型薄膜磁気ヘッド３２の磁気ギャップおよびインダクティブヘッド３３の磁気ギャップは、摺動型薄膜磁気ヘッドＨ４のテープ対向面Ｈ４Ａに露出している。ＭＲ型薄膜磁気ヘッド３２とインダクティブヘッド３３に流される電流は、電極３８を通じて流される。

【００７３】図５は、図４の摺動型薄膜磁気ヘッドＨ４のＭＲ型薄膜磁気ヘッド３２およびインダクティブヘッド３３周辺の部分断面図である。

【００７４】再生用のＭＲ型薄膜磁気ヘッド３２は、薄膜形成プロセスによって、アルミナチタンカーバイドからなる基板３１に、下地層である絶縁層３２ａを介して、下部シールド層３２ｂ、下部ギャップ層３２ｃ、ＭＲ素子層３２ｄ、ハードバイアス層（図示せず）、電極層３２ｅ、上部ギャップ層３２ｆおよび、上部シールド

層３２ｇが積層されて形成されている。下部シールド層３２ｂと上部シールド層３２ｇに挟まれた磁気テープに対向する部分がＭＲ型薄膜磁気ヘッド３２の磁気ギャップＧ５となる。

【００７５】ＭＲ型薄膜磁気ヘッド３２上に設けられる記録用のインダクティブヘッド３３は、ＭＲ型薄膜磁気ヘッド３２と同様に薄膜形成プロセスによって、上部シールド層と兼用の下部コア層３３ａ上に、ギャップ層３３ｂ、コイル層３３ｃ、絶縁層３３ｄ、および上部コア層３３ｅが積層されて形成されている。下部コア層３３ａと上部コア層３３ｅに挟まれた磁気テープに対向する部分がインダクティブヘッド３３の磁気ギャップＧ６となる。

【００７６】絶縁層３２ａ、下部ギャップ層３２ｃ、上部ギャップ層３２ｆ、ギャップ層３３ｂは、Al_2O_3またはSiO_2によって形成されている。また、下部シールド層３２ｂ、上部シールド層３２ｇ（下部コア層３３ａ）、上部コア層３３ｅは、パーマロイなどの軟磁性材料によって形成されている。電極層３２ｅ、コイル層３３ｃは、Ｃｕなどの導電性材料によって形成されている。ハードバイアス層は、ＰｔＣｏなどの硬磁性材料によって形成されている。絶縁層３３ｄはレジストによって形成されている。

【００７７】接着層３７のテープ対向面Ｈ４Ａにおけるテープ走行方向（Ｘ方向）の厚みは、テープ対向面Ｈ４Ａにおいて０であり、テープ対向面Ｈ４Ａからハイト方向（Ｙ方向）に向う距離が大きくなるにしたがって厚くなっている。

【００７８】したがって、磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることができる。

【００７９】接着層３７が、保護基板３５と直接接合されていると、磁気テープがテープ対向面Ｈ４Ａを摺動するときに、保護基板３５が接着層３７との界面において、損傷することがある。特に保護基板３５がアルミナチタンカーバイドなどの様に、結晶粒の脱粒が生じ易い材料によって形成されている場合に、保護基板３５が接着層３７との界面において、脱粒しやすい。接着層３７と保護基板３５とが接合されたときの接合力は、おもに、接着層を構成する分子と保護基板３７を構成する分子間に分子間力（ファン・デル・ワールス力）が働くことによって発生するものであるので、充分な接合強度を得られないためである。

【００８０】そこで、保護基板３５の接着層３７に対向する面に、例えばスパッタ法などで、Al_2O_3などの絶縁性材料からなる第２の保護膜である絶縁層３６を薄膜形成しておき、接着層３７が、絶縁層３６と接合されるようにする。

【００８１】スパッタ法では、一定の水準以上のエネルギー、例えば、１０ｅＶ以上のエネルギーをもった絶縁層３６の材料原子が、保護基板３５上に打ち込まれる。このとき、絶縁層３６の材料原子と保護基板３５の構成原子とを共有結合させることができる。したがって、保護基板３５と絶縁層３６との接合力が強力になるので、テープ対向面Ｈ４Ａを磁気テープが摺動するときに、保護基板３５と絶縁層３６との界面において、保護基板３５が損傷することが避けられる。

【００８２】なお、本実施の形態でも、絶縁層３４の接着層３７との接合面、および絶縁層３６の接着層３７との接合面の面積が、図１６に示された従来の摺動型薄膜磁気ヘッドの絶縁層１４の接着層１５との接合面、および保護基板１６の接着層１５との接合面の面積より狭くなることはない。

【００８３】したがって、接着層３７を介した、絶縁層３４と絶縁層３６との接合力が、従来の摺動型薄膜磁気ヘッドと比べて、低下することはない。

【００８４】本実施の形態の摺動型薄膜磁気ヘッドＨ４は、図３に示されるような磁気記録再生装置に設けられる回転ヘッド装置４０の摺動型薄膜磁気ヘッドＨ３の同等品として用いることができる。

【００８５】なお、本実施の形態では、絶縁層３４の接着層３７との接合面、および絶縁層３６の接着層３７との接合面が、テープ走行方向に垂直な平面に対する傾斜面とされているが、どちらか一方の接合面のみを傾斜面としてもかまわない。

【００８６】また、図１、図２、図４および図５に示された本発明の実施の形態は、再生用のＭＲ型薄膜磁気ヘッドの上層に、記録用のインダクティブヘッドが積層された複合型薄膜磁気ヘッドである。複合型薄膜磁気ヘッドであれば、一つの磁気ヘッドによって、記録および再生を行うことができる。また、インダクティブヘッドは、レジストフォトリソグラフィーなどの薄膜形成プロセスによって形成されるので、磁気ギャップの加工精度を向上させることが容易であり、狭トラック化が容易になる。

【００８７】また、保護基板２６、３５は、摺動型薄膜磁気ヘッドＨ３，Ｈ４のテープ対向面Ｈ３Ａ，Ｈ４Ａ上を磁気テープが走行するときに、ＭＲ型薄膜磁気ヘッド２２、３２やインダクティブヘッド２３、３３が過剰に摩耗することや、破損することを防止する目的で形成されている。保護基板２６、３５を形成する目的に適したアルミナチタンカーバイド以外の非磁性材料として、チタンカルシウム、カルシウムフェライトなどがある。

【００８８】また、保護膜である絶縁層２４、３４、３６を形成する絶縁性材料としてAl_2O_3以外に、SiO_2を用いてもかまわない。

【００８９】さらに、接着層２５、３７は、エポキシ系接着剤で形成されているので、接着工程を３００℃以下で行うことができ、ＭＲ型薄膜磁気ヘッドの特性を低下

させることがない。なお、エポキシ系接着剤のかわりに、低融点ガラス系接着剤によって、接着層２５、３７が形成されてもかまわない。

【００９０】図６から図１０は、図１または図２に示された本発明の実施の形態の摺動型薄膜磁気ヘッドの製造方法を説明するための斜視図である。

【００９１】まず、アルミナチタンカーバイドからなる基板２１上に、Al_2O_3やSiO_2などの絶縁性材料からなる下地層をスパッタ法により、薄膜形成する。次に、この下地層上に、ＭＲ型薄膜磁気ヘッド２２とインダクティブヘッド２３を順次薄膜形成する。インダクティブヘッド２３が形成された後に、Al_2O_3からなる保護膜である絶縁層２４を、スパッタ法によって薄膜形成する。図６は、ＭＲ型薄膜磁気ヘッド２２（図６では図示せず）とインダクティブヘッド２３（図６では図示せず）上に、絶縁層２４が積層された様子を示している。なお、ＭＲ型薄膜磁気ヘッド２２およびインダクティブヘッド２３を形成するときに、Ｃｕなどの導電性材料のメッキによって電極２７も形成する。

【００９２】図６では、ＭＲ型薄膜磁気ヘッド２２（図６では図示せず）、インダクティブヘッド２３（図６では図示せず）、および電極２７が一定の間隔をおいて基板上一面に形成されている（図６にはそのうち一部のみ図示している）。

【００９３】円形状の基板２１を点線で切断し図７のようにスライダバーにする。

【００９４】さらに、絶縁層２４上に、テープ対向面２４Ａから、テープ対向面２４Ａからの距離が大きくなるにつれて、深くなる溝２４ａを形成する。図７のように、絶縁層２４上に電極２７が形成されているときには、溝２４ａを電極２７にかからないように形成する。

【００９５】一方、図８に示されたアルミナチタンカーバイドからなる保護基板２６を点線で切断し、スライダバーにする。

【００９６】スライダバーに切断された保護基板２６の一端面を研磨して、図９のように傾斜面２６ａを形成する。

【００９７】さらに、傾斜面２６ａが形成された保護基板２６と溝２４ｂが形成された基板２１とを、図１０のように傾斜面２６ａと溝２４ｂを対向させ、接着層２５となるエポキシ系接着剤によって、保護基板２６、基板２１、および絶縁層２４それぞれのテープ対向面２６Ｂ、２１Ａ、２４Ａが平坦面となるように接着する。また、この時、接着剤がテープ対向面に露出しないように接着固定する。

【００９８】なお、保護基板２６の傾斜面２６ａおよび絶縁層２４の溝２４ｂは、必ずしも両方を形成する必要はなく、どちらか一方のみが形成されるだけでもかまわない。

【００９９】さらに、テープ対向面が、円筒研削またはならい研削されることによってＲ形状に加工され、点線で切断され、図１に示されるような個々の摺動型薄膜磁気ヘッドＨ３になる。

【０１００】また、図４および図５に示された薄膜磁気ヘッドＨ４の製造方法では、まず、アルミナチタンカーバイドからなる円形状の基板３１上に、Al_2O_3やSiO_2などの絶縁性材料からなる下地層をスパッタ法により、薄膜形成する。次に、この下地層上に、ＭＲ型薄膜磁気ヘッド３２とインダクティブヘッド３３を順次薄膜形成する。インダクティブヘッド３３が形成された後に、Al_2O_3からなる第１の保護膜である絶縁層３４を、スパッタ法によって薄膜形成する。

【０１０１】なお、ＭＲ型薄膜磁気ヘッドおよびインダクティブヘッドを形成するときに、Ｃｕなどの導電性材料のメッキによって電極３８も形成する。

【０１０２】ＭＲ型薄膜磁気ヘッド３２、インダクティブヘッド３３、および電極３８を、一定の間隔をおいて一枚の円形状の基板上一面に、複数個形成する。

【０１０３】円形状の基板３１を切断し、スライダバーにする。さらに、絶縁層３４上に、テープ対向面から、このテープ対向面からの距離が大きくなるにつれて深くなる溝を形成する。絶縁層３４上に電極３８が形成されているときには、溝を電極３８にかからないように形成する。

【０１０４】ここまでは、先述した図１および図２の摺動型薄膜磁気ヘッドの製造方法として、図６および図７を用いて説明した工程と同じである。

【０１０５】図４および図５の摺動型薄膜磁気ヘッドＨ４の製造方法では、図１１のように、アルミナチタンカーバイドからなる保護基板３５上に、Al_2O_3からなる第２の保護膜である絶縁層３６をスパッタ法などによって薄膜形成する。

【０１０６】絶縁層３６が積層された保護基板３５を、図１１の点線に沿って切断し、スライダバーとする。このスライダバーの絶縁層３６を研磨して、図１３のように傾斜面３６ａを形成する。

【０１０７】さらに、傾斜面３６ａが形成された保護基板３５と溝３４ａが形成された基板３１とを、図１２のように傾斜面３６ａと溝３４ａを対向させ、接着層３７となるエポキシ系接着剤によって、保護基板３５、絶縁層３６、基板３１、および絶縁層３４それぞれのテープ対向面３５Ｂ、３６Ａ、３１Ａ、３４Ａが平坦面となるように接着する。また、この時、接着剤がテープ対向面に露出しないように接着固定する。

【０１０８】なお、絶縁層３６の傾斜面３６ａおよび絶縁層３４の溝３４ａは、必ずしも両方を形成する必要はなく、どちらか一方のみが形成されるだけでもかまわない。

【０１０９】さらに、テープ対向面が、円筒研削またはならい研削されることによってＲ形状に加工され、点線

で切断され、図４に示されるような個々の摺動型薄膜磁気ヘッドＨ４になる。

【０１１０】このように、本発明の摺動型薄膜磁気ヘッドの製造方法によれば、接着層が、テープ対向面に露出せず、磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、前記テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることができる摺動型薄膜磁気ヘッドを形成することができる。

【０１１１】なお、基板２１、保護基板２６、基板３１、保護基板３５は、チタンカルシウム、カルシウムフェライトなどによって形成されていてもよい。また、絶縁層２４、絶縁層３４、絶縁層３６は、SiO_2によって形成されていてもよい。

【０１１２】また、絶縁層２４と保護基板２６を接合する接着剤、および絶縁層３４と絶縁層３６を接合する接着剤には、低融点ガラス系接着剤を用いてもよい。

【０１１３】このように、本実施の形態の摺動型薄膜磁気ヘッドＨ３、Ｈ４は、薄膜形成プロセスによって形成されるので、一度に大量生産でき、小型化も容易である。また、トラック幅を１０μm以下にする場合でも、磁気ギャップの加工精度を、必要なだけ向上させることができる。

【０１１４】

【発明の効果】以上詳細に説明した本発明によれば、接着層が、テープ対向面に露出せず、磁気テープが、磁気ヘッドのテープ対向面を摺動する際に、前記テープ対向面に磁粉が付着することを防止でき、磁気テープの磁気記録特性を向上させることができる摺動型薄膜磁気ヘッドを形成することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態を示す摺動型薄膜磁気ヘッドの斜視図。

【図２】図１の摺動型薄膜磁気ヘッドの部分断面図。

【図３】図１の摺動型薄膜磁気ヘッドを用いて構成された回転ヘッド型磁気記録再生装置の平面図。

【図４】本発明の他の実施の形態を示す摺動型薄膜磁気ヘッドの斜視図。

【図５】図４の摺動型薄膜磁気ヘッドの部分断面図。

【図６】本発明の摺動型薄膜磁気ヘッドの製造方法における、基板上にＭＲ型薄膜磁気ヘッド、インダクティブヘッド、および、保護膜である絶縁層が積層された状態を示す斜視図。

【図７】図６の基板が、点線で切断されてスライダバーとされた状態を示す斜視図。

【図８】保護基板となる基板を示す斜視図。

【図９】図８の基板が点線で切断されてスライダバーとされ、傾斜面が形成された状態を示す斜視図。

【図１０】図７のスライダバーと図９のスライダバーが接合された状態を示す斜視図。

【図１１】保護基板となる基板上に、絶縁層が薄膜形成された状態を示す斜視図。

【図１２】図１１の基板が点線で切断されてスライダバーとされ、傾斜面が形成された状態を示す斜視図。

【図１３】ＭＲ型薄膜磁気ヘッド、インダクティブヘッド、および、第１の保護膜である絶縁層が積層されたスライダバーと図１２のスライダバーが接合された状態を示す斜視図。

【図１４】従来の磁気ヘッドの斜視図。

【図１５】回転ヘッド型磁気記録再生装置の平面図。

【図１６】従来の摺動型薄膜磁気ヘッドの斜視図。

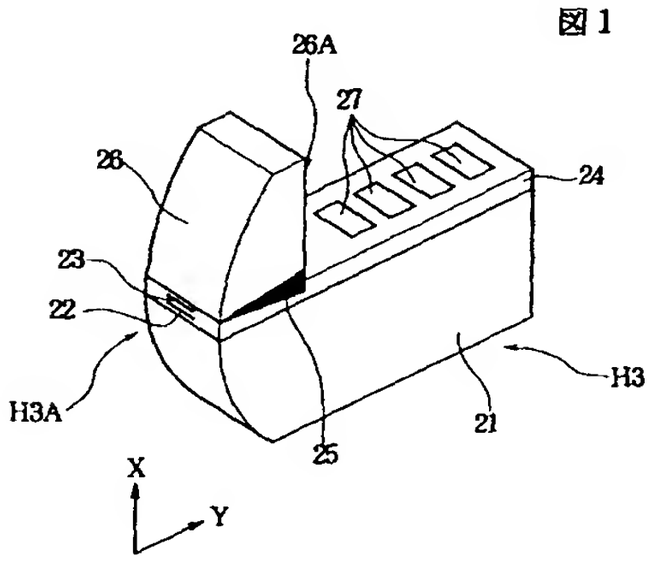
【図17】図１６の摺動型薄膜磁気ヘッドの部分断面図。

【符号の説明】

２１、３１　基板
２２、３２　ＭＲ型薄膜磁気ヘッド
２３、３３　インダクティブヘッド
２４、３４、３６　絶縁層
２６、３５　保護基板
２５、３７　接着層
２８、３８　電極

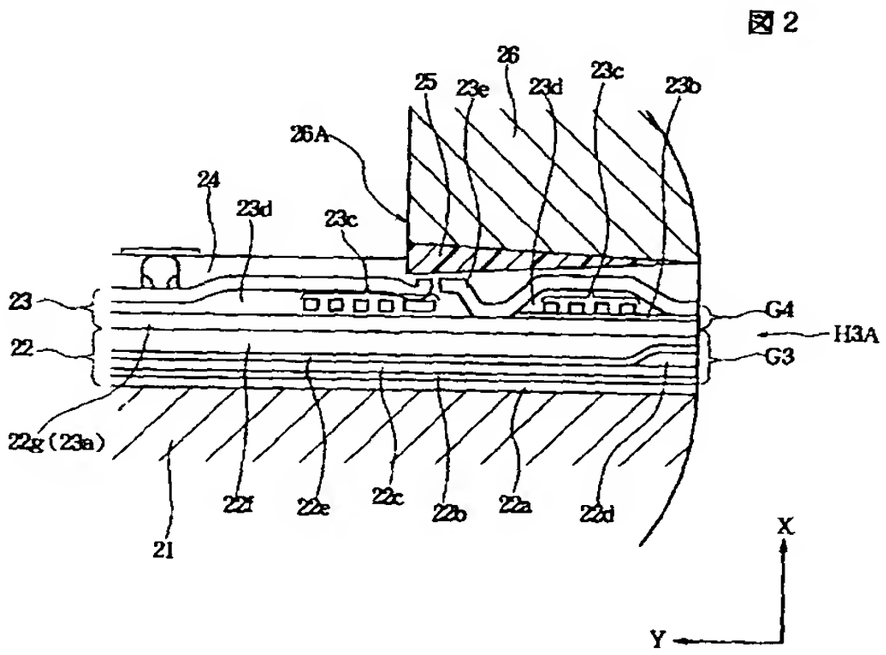
【図１】

図１



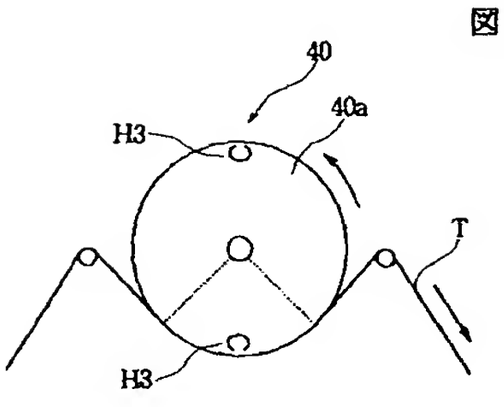
【図２】

図２



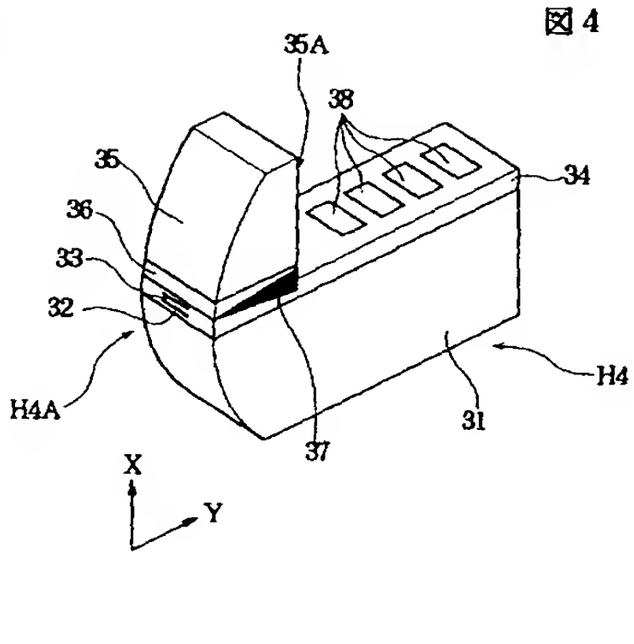
【図３】

図３



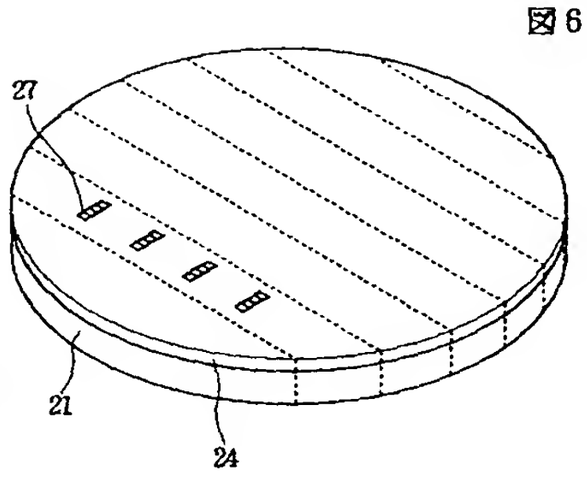
【図４】

図４



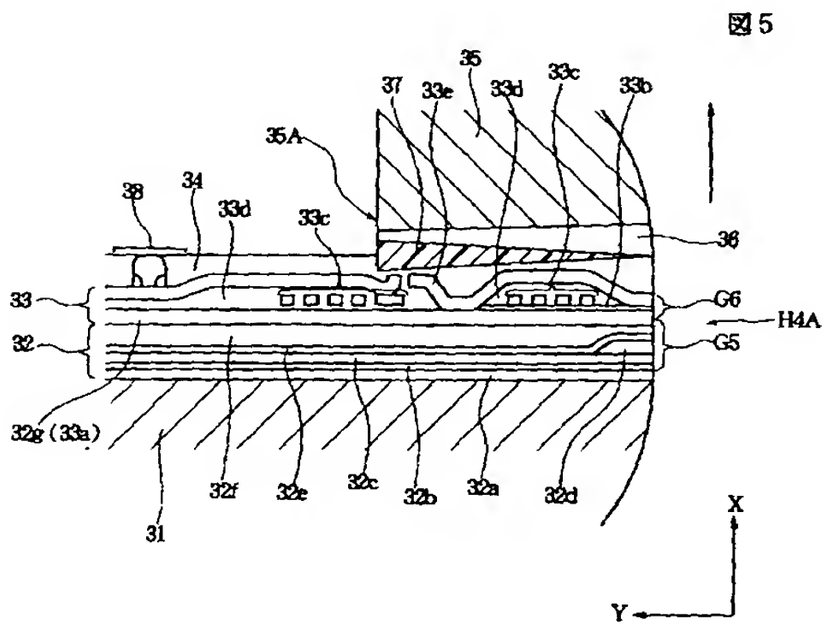
【図６】

図６



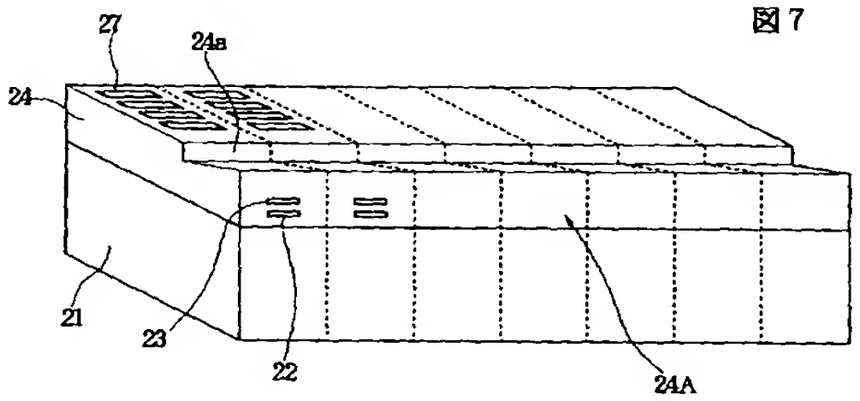
【図５】

図５



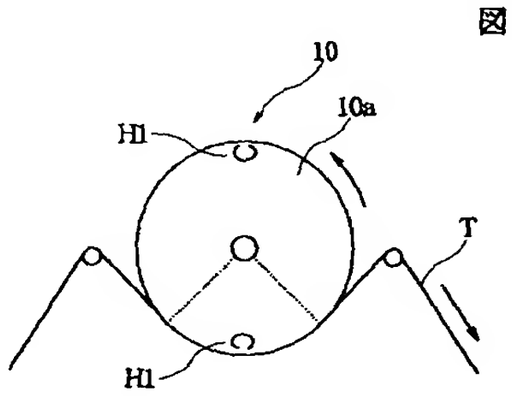
【図７】

図７



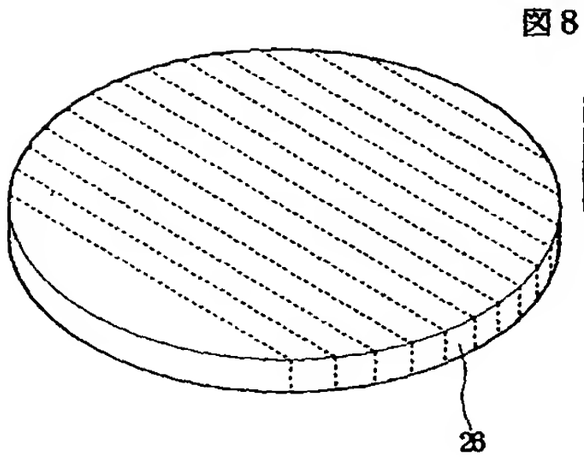
【図１５】

図15



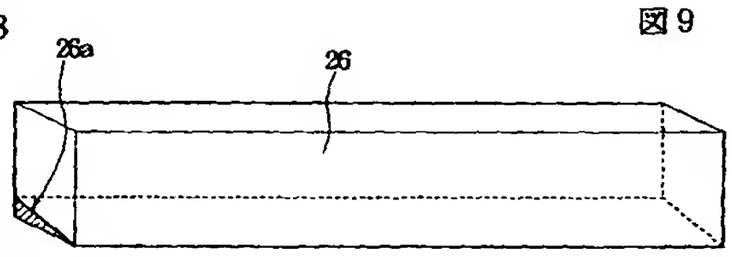
【図８】

図８



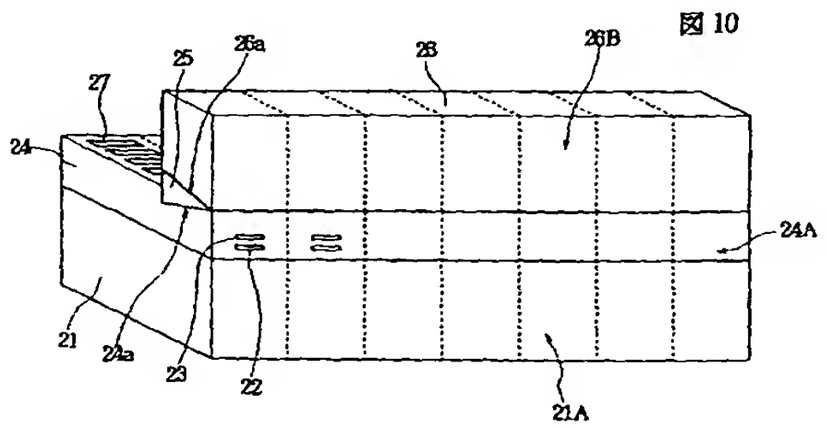
【図９】

図９



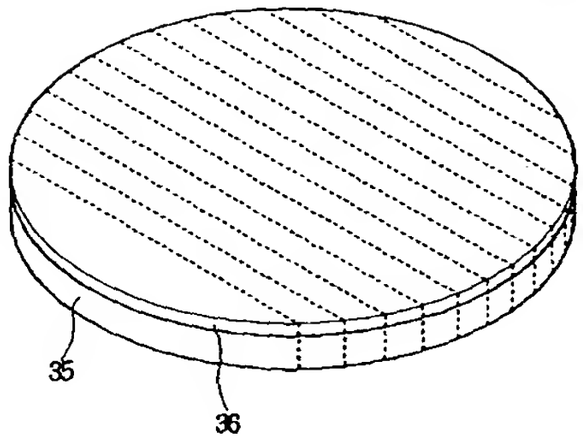
【図１０】

図10



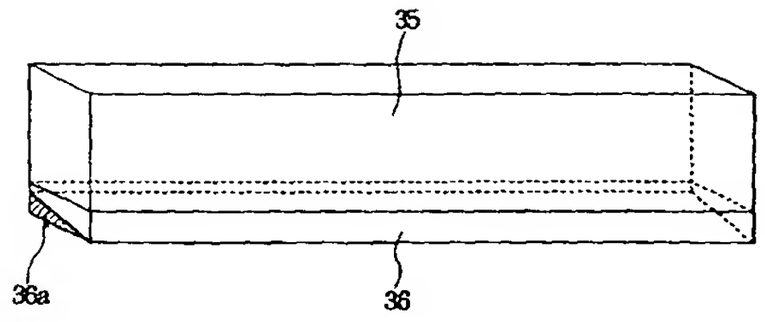
【図１１】

図 11



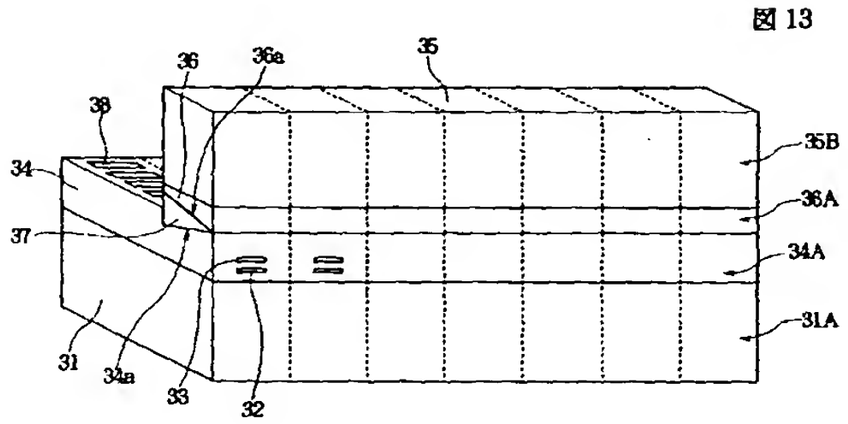
【図１２】

図 12



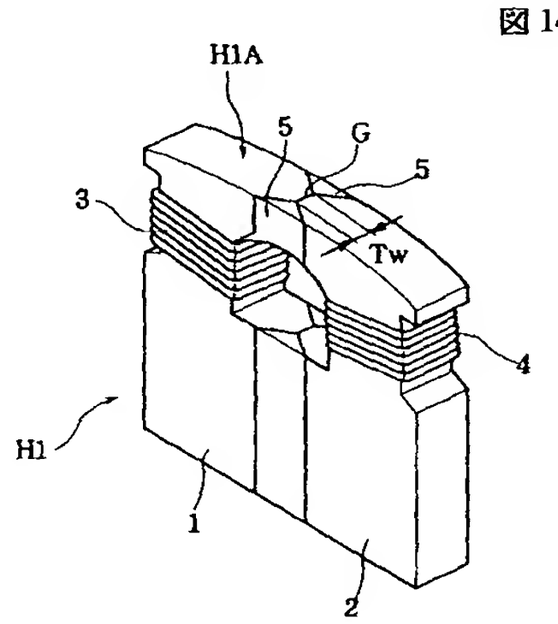
【図１３】

図 13



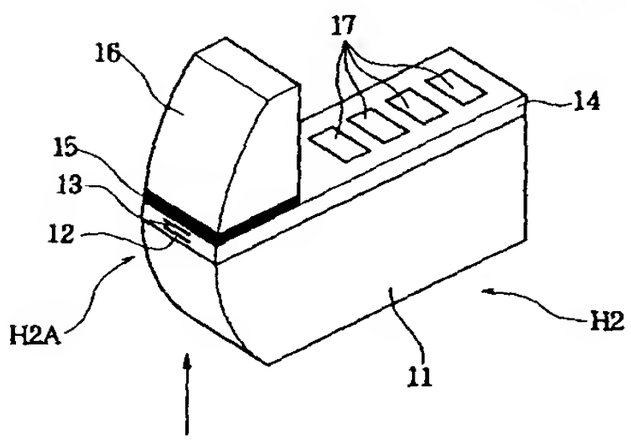
【図１４】

図 14



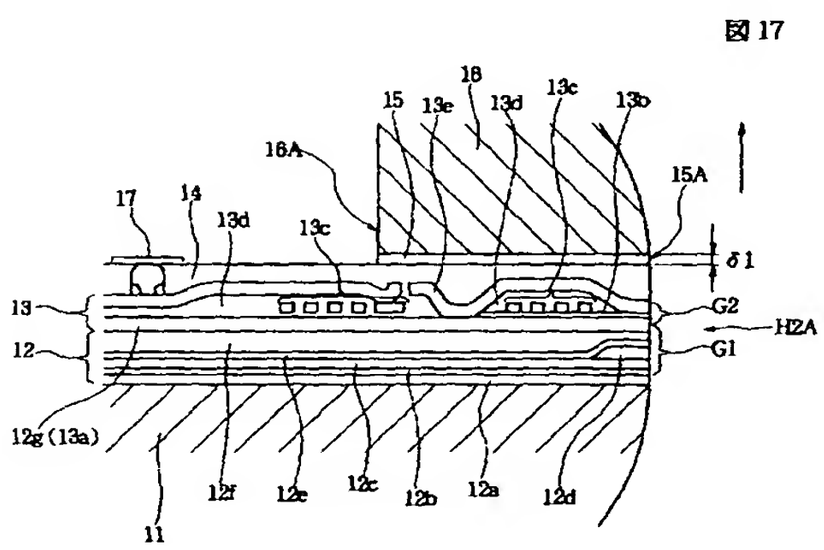
【図１６】

図 16



【図１７】

図 17



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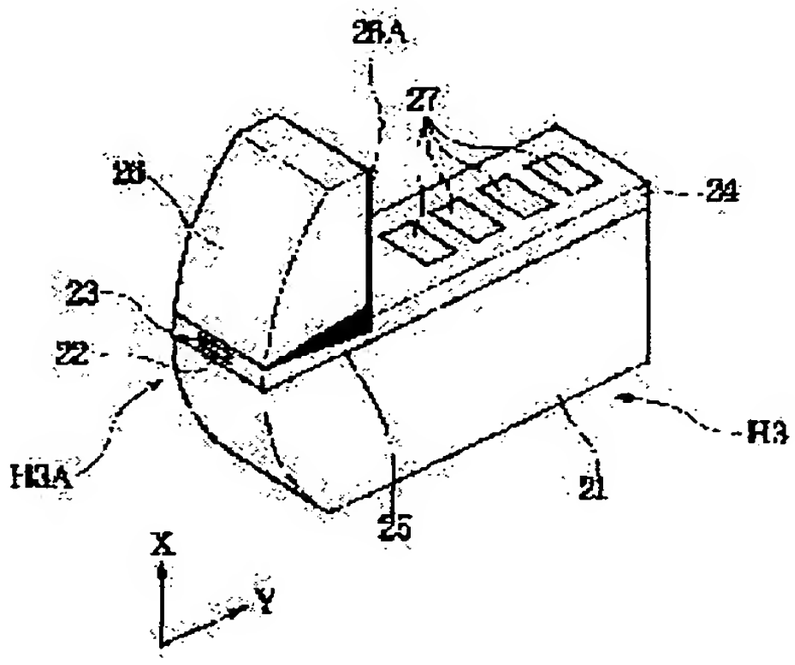
(72)Inventor : HASHIMOTO MIORI

(54) SLIDING TYPE THIN FILM MAGNETIC HEAD AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain the sliding type thin film magnetic head, as well as its manufacturing method, which is capable of preventing magnetic particles from sticking to the face of the magnetic head opposite to a magnetic tape when the tape slides on the face and which therefore is capable of improving the recording characteristic of the magnetic tape.
SOLUTION: With the adhesive layer 25 unexposed to the face H3A opposite to a tape, the thickness of the layer 25 in the tape running direction (X direction) is made thicker as a distance becomes longer from the opposite face H3A in the height direction (Y direction). Consequently, when the magnetic tape slides on the face H3A opposite to the tape, magnetic particles are prevented from sticking to the face H3A.



LEGAL STATUS

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[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, It has the protective-group board formed with the thin film magnetic head, the protective coat which consists of an insulating material and the magnetic material, or the non-magnetic material. In the slid type thin film magnetic head by which the magnetic gap of the aforementioned thin film magnetic head is exposed to the tape opposed face of the aforementioned magnetic head It is the slid type thin film magnetic head to which the aforementioned protective coat is joined to the aforementioned protective-group board through the glue line, and this glue line is characterized by forming the direction of the back side of the height direction thickly rather than the aforementioned tape opposed face side.
[Claim 2] It has the following and the 1st protective coat of the above and the 2nd protective coat of the above are joined through the glue line. this glue line It is characterized by forming the back side of the height direction thickly rather than the aforementioned tape opposed face side. The ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, The slid type thin film magnetic head by which it has the protective-group board formed with the thin film magnetic head, the protective coat which consists of an insulating material and the magnetic material, or the non-magnetic material, and the magnetic gap of the thin film magnetic head is exposed to the tape opposed face of the aforementioned magnetic head. The aforementioned protective coat is the 1st protective coat by which thin film formation was carried out on the aforementioned thin film magnetic head formed on the aforementioned substrate. The 2nd protective coat by which thin film formation was carried out at the aforementioned protective-group board.
[Claim 3] The aforementioned glue line is the slid type thin film magnetic head according to claim 1 or 2 which has not appeared in a tape opposed face.
[Claim 4] The thickness of the aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 3 which increases continuously until it reaches the back end side of the aforementioned protective-group board toward the height direction with a tape opposed face as the starting point.
[Claim 5] The slid type thin film magnetic head according to claim 1 to 4 whose aforementioned thin film magnetic head is MR type thin film magnetic head.
[Claim 6] The slid type thin film magnetic head according to claim 1 to 4 whose aforementioned thin film magnetic head is the compound-die thin film magnetic head of MR type thin film magnetic head and the inductive magnetic head.
[Claim 7] The slid type thin film magnetic head according to claim 1 to 6 in which the aforementioned protective-group board is formed with non-magnetic materials, such as an alumina titanium carbide, titanium calcium, and a calcium ferrite.
[Claim 8] The aforementioned protective coat is the slid type thin film magnetic head according to claim 1 to 7 currently formed of aluminum 2O3 or SiO2.
[Claim 9] The aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 8 currently formed by epoxy system adhesives or low-melting-glass system adhesives.
[Claim 10] The manufacture method of the slid type thin film magnetic head characterized by providing the following. (a) The process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material. (b) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer. (c) The process which carries out thin film formation of the protective coat which consists of an insulating material on the aforementioned thin film magnetic head. (d) Cut the aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the protective coat was formed. The process used as a slider bar, and the process which forms the slot which becomes deep on the aforementioned protective coat of the (e) aforementioned slider bar as it separates from the aforementioned tape opposed face, (f) The process which cuts the substrate used as a protective-group board, and is used as a slider bar, and the end side of the (g) aforementioned slider bar are ground. The process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the slot was formed on the protective coat of the process which forms an inclined plane, and the process of (h) above (e), and the slider bar with which the inclined plane was formed of the process of the above (g) with adhesives.
[Claim 11] The manufacture method of the slid type thin film magnetic head characterized by providing the following. (i) Process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material. (j) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer. (k) The process which carries out thin film formation of the 1st protective coat which consists of an insulating material on the aforementioned thin film magnetic head by the vacuum forming-membranes method. (l) Cut the aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the 1st protective coat was formed. The process used as a slider bar, and the process which forms the slot which becomes deep on the aforementioned protective coat of the (m) aforementioned slider bar as it separates from the aforementioned tape opposed face, (n) The process which carries out thin film formation of the 2nd protective coat by the vacuum forming-membranes method on the substrate used as a protective-group board, (o) The process which cuts the substrate in which the 2nd protective coat of the above was formed, and is used as a slider bar, (p) The slider bar with which the slot was formed on the protective coat of the process which grinds the 2nd protective coat of the above and forms an inclined plane, and the process of (q) above (m), The process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the inclined plane was formed of the process of the above (p) with adhesives.
[Claim 12] The manufacture method of the slid type thin film magnetic head according to claim 10 or 11 that the aforementioned thin film magnetic head formed in the process of the above (b) or the above (j) is MR type thin film magnetic head.
[Claim 13] The manufacture method of the slid type thin film magnetic head according to claim 10 or 11 that the aforementioned thin film magnetic head formed in the process of the above (b) or the above (j) is the compound-die thin film magnetic head of MR type thin film

magnetic head and the inductive magnetic head.
[Claim 14] The manufacture method of the slid type thin film magnetic head according to claim 10 to 13 that the substrate used as the aforementioned protective-group board used at the process of the above (f) or the above (n) is formed with non-magnetic materials, such as an alumina titanium carbide, titanium calcium, and a calcium ferrite.
[Claim 15] The manufacture method of the slid type thin film magnetic head according to claim 10 to 14 which forms the aforementioned protective coat or the 1st protective coat of the above, and the 2nd protective coat of the above by aluminum 2O3 or SiO2 in the process of the above (c), (k), or (n).
[Claim 16] The manufacture method of the slid type thin film magnetic head according to claim 10 to 15 of pasting up the aforementioned protective coat, the aforementioned protective-group board, or the 1st protective coat of the above and the 2nd protective coat of the above with epoxy system adhesives or low-melting-glass system adhesives in the process of the above (h) or (q).

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] In case the slid type thin film magnetic head which constitutes the magnetic recorder and reproducing device of the visual equipment which records a record signal on a magnetic tape and is reproduced, or the data magnetic recorder and reproducing device for computers is started, especially a magnetic tape slides on the tape opposed face of the magnetic head, this invention can prevent that a magnetic powder adheres to the aforementioned tape opposed face, and relates to the slid type thin film magnetic head which can raise the magnetic-recording property of a magnetic tape, and its manufacture method.
[0002]
[Description of the Prior Art] In the magnetic recording medium in a visual equipment, or the magnetic recorder and reproducing device which saves the data for computers, the magnetic head is carried in the rotating drum of rotary-head equipment, while a magnetic tape contacts and runs by helical tracing to the aforementioned rotating drum, the aforementioned rotating drum rotates, and record operation is performed by the helical scan to a magnetic tape.
[0003] The perspective diagram showing an example of the magnetic head of the former [drawing 14] and drawing 15 are the plans showing the rotary-head equipment of a magnetic recorder and reproducing device with which the aforementioned magnetic head was carried.
[0004] As shown in drawing 14 , the magnetic head H1 has the cores 1 and 2 formed by magnetic materials of high permeability, such as a ferrite, in the sliding surface with magnetic tape T, a magnetic material layer is infixed in the opposite section with cores 1 and 2, and magnetic-gap G is formed. The coils 3 and 4 for record / reproduction in the aforementioned cores 1 and 2 are **********. Moreover, in tape opposed face H1A, the V character-like gap regulation slots 5 and 5 are formed in the both-sides section of cores 1 and 2, and the width of recording track Tw of magnetic-gap G is specified. In addition, it fills up with SiO2, the non-magnetic material, for example, the junction glass, of abrasion resistance, etc. in this gap regulation slot 5 and 5.
[0005] With the rotary-head equipment 10 formed in the magnetic recorder and reproducing device shown in drawing 15 , a fixed drum (not shown) is fixed, rotating-drum 10a of this and the same axle is supported by the aforementioned fixed drum lifting free [rotation], and the rotation drive of the rotating-drum 10a is carried out in the direction of an arrow by the power of a motor. Magnetic tape T which is a magnetic-recording medium is twisted around rotary-head equipment 10 the degree of predetermined angle by helical tracing, and runs in the direction of an arrow. In the meantime, rotating-drum 10a rotates and the magnetic head H1 carried in this rotating-drum 10a scans magnetic tape T. With the rotary-head equipment of drawing 15 , 1 set of magnetic heads H1 and H1 are formed in the position which counters mutually.
[0006] By the magnetic head H1 shown in drawing 14 , magnetic-gap G is formed by the predetermined width of recording track Tw by carrying out the grinding process of the opposite section of a core 1 and a core 2.
[0007] In recent years, in order to realize high recording density-ization to a magnetic-recording medium in the magnetic recorder and reproducing device of a visual equipment, the data magnetic recorder and reproducing device for computers, etc., the formation of a ** truck and RF-izing which narrow the width of recording track are attained.
[0008] It is necessary to make small the width of recording track Tw of a magnetic gap for the formation of a ** truck. Moreover, it is necessary to raise the process tolerance of a magnetic gap as ** truck-ization is advanced. Especially, recently, the format of 10 micrometers or less is also increasingly proposed for the width of recording track Tw. However, in the magnetic head H1 shown in drawing 14 , it is becoming difficult to raise a process tolerance as ** truck-ization is advanced, since magnetic-gap G is formed by the grinding process.
[0009] Then, since it corresponds to ** truck-ization, using the thin film magnetic head formed of a thin film formation process is proposed.
[0010] Drawing 16 is the perspective diagram of the slid type thin film magnetic head. MR type thin film magnetic head 12 for reproduction, the inductive head 13 for record, and the insulating layer 14 that is a protective coat were formed of the thin film formation process on the substrate 11 which consists of an alumina titanium carbide, and the protective-group board 16 which consists of an alumina titanium carbide with the epoxy system adhesives 15 on an insulating layer 14 has pasted up further this slid type thin film magnetic head H2.
[0011] The magnetic gap of MR type thin film magnetic head 12 and the magnetic gap of an inductive head 13 are exposed to tape opposed face H2A of the slid type thin film magnetic head. The current passed by MR type thin film magnetic head 12 and the inductive head 13 is given through an electrode 17.
[0012]
[Problem(s) to be Solved by the Invention] Drawing 17 is the expansion fragmentary sectional view of the MR type thin film magnetic-head [of the slid type thin film magnetic head H2 of drawing 16] 12, and inductive head 13 circumference.
[0013] Through insulating-layer 12a which is a ground layer, the laminating of lower shield layer 12b, lower gap layer 12c, 12d of MR element layers, electrode layer 12e, 12f of up gap layers, and the 12g of the up shield layers is carried out, and MR type thin film magnetic head 12 for reproduction is formed in the substrate 11 which consists of an alumina titanium carbide. The portion which counters the magnetic tape inserted into lower shield layer 12b and 12g of up shield layers serves as the magnetic gap G1 of MR type thin film magnetic head 12.
[0014] On lower core layer 13a of an up shield layer and combination, the laminating of gap layer 13b, coil layer 13c, 13d of insulating layers, and the up core layer 13e is carried out, and the inductive head 13 for record formed on MR type thin film magnetic head 12 for reproduction is formed. The portion which counters the magnetic tape inserted into lower core layer 13a and up core layer 13e serves as the magnetic gap G2 of an inductive head 13.
[0015] Furthermore, the laminating of the insulating layer 14 is carried out on an inductive head 13, and the protective-group board 16 which consists of an alumina titanium carbide is joined through the glue line 15 which consists of epoxy resin adhesive on an insulating layer 14.
[0016] In the slid type thin film magnetic head shown in drawing 16 and drawing 17 , the thickness of a glue line 15 is thickness sigma1 fixed until a glue line 15 reaches [from the field exposed to tape opposed face H2A] the field exposed to the back end side 16A side of the protective-group board 16. Therefore, the glue line 15 is exposed to tape opposed face H2A by thickness sigma1.

[0017] When the glue line 15 was exposed to tape opposed face H2A by such thickness sigma1 and a magnetic tape slid on tape opposed face H2A, the magnetic powder separated from the magnetic tape and the problem of adhering to exposed-surface 15A of a glue line 15 had arisen.
[0018] If a magnetic powder separates from a magnetic tape, the magnetic properties of a magnetic tape will fall [the part in which the magnetic powder separated]. Moreover, in the state where the magnetic powder has adhered to exposed-surface 15A of a glue line 15, when a magnetic tape slides on exposed-surface 15A of a glue line 15, a magnetic powder may carry out the reattachment to the arbitrary parts of a magnetic tape. When it arises that a magnetic powder carries out the reattachment to the arbitrary parts of a magnetic tape, it becomes impossible to record a signal correctly on a magnetic tape, and it becomes impossible to reproduce correctly the signal currently originally recorded.
[0019] this invention is for solving the above-mentioned conventional technical problem, in case a magnetic tape slides on the tape opposed face of the magnetic head, can prevent that a magnetic powder adheres to the aforementioned tape opposed face, and aims at offering the slid type thin film magnetic head which can raise the magnetic-recording property of a magnetic tape, and its manufacture method.
[0020]
[Means for Solving the Problem] this invention on the substrate formed with the magnetic material or the non-magnetic material The ground layer which consists of an insulating material, the thin film magnetic head, the protective coat which consists of an insulating material, And have the protective-group board formed with the magnetic material or the non-magnetic material, and the magnetic gap of the aforementioned thin film magnetic head sets to the slid type thin film magnetic head exposed to the tape opposed face of the aforementioned magnetic head. The aforementioned protective coat is joined to the aforementioned protective-group board through the glue line, and this glue line is characterized by forming the back side of the height direction thickly rather than the aforementioned tape opposed face side.
[0021] In the slid type thin film magnetic head of this invention, it is thick as the aforementioned glue line separates the thickness of the glue line which joins the aforementioned protective-group board to the aforementioned protective coat toward the height direction (the direction of Y) from the aforementioned tape opposed face.
[0022] Therefore, the adhesive strength of a protective layer and a protective-group board is fully securable, since area of the glue line moreover exposed to the tape opposed face of the magnetic head is made to the minimum, it can prevent that many magnetic powders adhere to the aforementioned tape opposed face, and the magnetic-recording property of a magnetic tape can be raised.
[0023] this invention moreover, on the substrate formed with the magnetic material or the non-magnetic material The ground layer which consists of an insulating material, the thin film magnetic head, the protective coat which consists of an insulating material, And have the protective-group board formed with the magnetic material or the non-magnetic material, and the magnetic gap of the thin film magnetic head sets to the slid type thin film magnetic head exposed to the tape opposed face of the aforementioned magnetic head. The 1st protective coat by which thin film formation was carried out on the aforementioned thin film magnetic head by which the aforementioned protective coat was formed on the aforementioned substrate, It has the 2nd protective coat by which thin film formation was carried out to the aforementioned protective-group board, the 1st protective coat of the above and the 2nd protective coat of the above are joined to it through the glue line, and this glue line is characterized by forming the back side of the height direction thickly rather than the aforementioned tape opposed face side.
[0024] If the aforementioned glue line is directly joined to the aforementioned protective-group board, when a magnetic tape will slide on the aforementioned tape opposed face, the aforementioned protective-group board may be damaged in an interface with the aforementioned glue line. When especially the aforementioned protective-group board is formed like the alumina titanium carbide of the material which degraining of crystal grain tends to produce, the aforementioned protective-group board tends to degrain in an interface with the aforementioned glue line. Since it generates when intermolecular force (Van der Waals force) works between the molecule which mainly constitutes adhesives, and the molecule which constitutes the aforementioned protective-group board, the junction force of the aforementioned glue line and the aforementioned protective-group board is because sufficient bonding strength cannot be obtained.
[0025] Then, thin film formation of the 2nd protective coat which consists of an insulating material is carried out by the spatter etc., and the aforementioned glue line is joined to this 2nd protective coat by the field which counters the aforementioned glue line of the aforementioned protective-group board.
[0026] In a spatter, the material atom of the 2nd protective coat of the above with the energy beyond a fixed level, for example, energy 10eV or more, is driven in on the aforementioned protective-group board. At this time, covalent bond of the material atom of the 2nd protective coat of the above and the composition atom of the aforementioned protective-group board can be carried out. Therefore, since the junction force of the aforementioned protective-group board and the 2nd protective coat of the above becomes powerful, it is avoided that a protective-group board is damaged in an interface with the aforementioned glue line.
[0027] And adhesion of a magnetic powder can be suppressed by making into the minimum area which the glue line currently formed between protective layers in this way exposes to a tape opposed face.
[0028] Moreover, as for the aforementioned glue line, having not appeared in a tape opposed face is desirable. However, it is possible when a glue line is slightly exposed to a tape opposed face.
[0029] Moreover, increasing continuously is desirable until the thickness of the aforementioned glue line reaches the back end side of the aforementioned protective-group board toward the height direction with a tape opposed face as the starting point.
[0030] However, the thickness of the aforementioned glue line may be thick gradually in the height direction, or the thickness of a glue line may once become thick towards the height direction, and may become thin towards the height direction after that.
[0031] In addition, as the aforementioned thin film magnetic head, only MR type thin film magnetic head for reproduction may be formed, and the compound-die thin film magnetic head by which the laminating of the inductive magnetic head for record was carried out to the upper layer of MR type thin film magnetic head for reproduction may be formed.
[0032] If it is the compound-die thin film magnetic head by which the laminating of the inductive head for record was carried out to the upper layer of MR type thin film magnetic head for reproduction, the one magnetic head can perform record and reproduction. Moreover, since the aforementioned inductive head is formed of thin film formation processes, such as resist photo lithography, it is easy to raise the process tolerance of a magnetic gap, and ** truck-ization becomes easy. However, the magnetic field strength which an inductive head generates is weaker than the magnetic field strength which the bulked type magnetic head which consists of copper wire coiled around the core of a magnetic material used well and this core generates, in order to record a signal on a magnetic tape conventionally. Therefore, when using an inductive head as the magnetic head for recording a record signal on a magnetic tape, it is necessary to make tape ** of a magnetic tape thin and to raise the record sensitivity by the side of a magnetic tape.
[0033] There are for example, an alumina titanium carbide, titanium calcium, a calcium ferrite, etc. in the non-magnetic material which forms the aforementioned protective-group board.
[0034] When a magnetic tape runs the tape opposed face top of the slid type thin film magnetic head, the aforementioned protective-group board is formed in order to prevent wearing out superfluously MR type thin film magnetic head and an inductive head or damaging.
[0035] Since the non-magnetic material mentioned above is the stiff quality of the material, it is suitable as a material which forms the aforementioned protective-group board.

[0036] Moreover, there are aluminum 2O3 or SiO2 in an insulating material which forms the 1st protective coat of the above, and the 2nd protective coat of the above.
[0037] Moreover, as for the aforementioned glue line, it is desirable to be formed by epoxy system adhesives or low-melting-glass system adhesives.
[0038] High-melting point textile-glass-yarn adhesives have been used for manufacture of the conventional magnetic head as shown in drawing 8 . However, it is necessary to heat high-melting point textile-glass-yarn adhesives at the temperature of about 800 degrees C at the time of junction. However, if the elevated temperature of no less than 800 degrees C **, the property of MR type thin film magnetic head which constitutes this invention will deteriorate. The temperature which MR type thin film magnetic head can bear is to about 300 degrees C generally. Therefore, in this invention, it is desirable that the aforementioned glue line is formed by the epoxy system adhesives or low-melting-glass system adhesives which can perform an adhesion process below 300 degrees C.
[0039] Moreover, the manufacture method of the slid type thin film magnetic head of this invention (a) The process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, (b) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer, and the process which carries out thin film formation of the protective coat which consists of an insulating material on the (c) aforementioned thin film magnetic head, (d) The aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the protective coat was formed are cut. The process used as a slider bar, and the process which forms the slot which becomes deep on the aforementioned protective coat of the (e) aforementioned slider bar as it separates from the aforementioned tape opposed face, (f) according to the process which cuts the substrate used as the aforementioned protective-group board, and is used as a slider bar, the process which grinds the end side of the (g) aforementioned slider bar, and forms an inclined plane, and the process of (h) above (e) It is characterized by having the process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the slot was formed on the protective coat, and the slider bar with which the inclined plane was formed of the process of the above (g) with adhesives.
[0040] By using the above-mentioned manufacture method, the glue line which consists of the aforementioned adhesives can form the slid type thin film magnetic head which is thick according to the other side in the height direction (the direction of Y) from the aforementioned tape opposed face.
[0041] That is, in case a magnetic tape slides on the tape opposed face of the magnetic head, it can prevent that a magnetic powder adheres to the aforementioned tape opposed face, and the slid type thin film magnetic head which can raise the magnetic-recording property of a magnetic tape can be formed.
[0042] Or the manufacture method of the slid type thin film magnetic head of this invention (i) The process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, (j) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer, and the process which carries out thin film formation of the 1st protective coat which consists of an insulating material on the (k) aforementioned thin film magnetic head by the vacuum forming-membranes method, (l) The aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the 1st protective coat of the above was formed are cut. The process used as a slider bar, and the process which forms the slot which becomes deep on the aforementioned protective coat of the (m) aforementioned slider bar as it separates from the aforementioned tape opposed face, (n) The process which carries out thin film formation of the 2nd protective coat by the vacuum forming-membranes method on the substrate used as the aforementioned protective-group board, (o) according to the process which cuts the substrate in which the 2nd protective coat of the above was formed, and is used as a slider bar, the process which grinds the 2nd protective coat of (p) above, and forms an inclined plane, and the process of (q) above (m) It is characterized by having the process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the slot was formed on the protective coat, and the slider bar with which the aforementioned inclined plane was formed of the process of the above (p) with adhesives.
[0043] In this invention, thin film formation of the 2nd protective coat which consists of an insulating material by the spatter etc. on the aforementioned protective-group board is carried out in the process of the above (n).
[0044] In a spatter, the material atom of the 2nd protective coat of the above with the energy beyond a fixed level, for example, energy 10eV or more, is driven in on the aforementioned protective-group board. At this time, covalent bond of the material atom of the 2nd protective coat of the above and the composition atom of the aforementioned protective-group board can be carried out. Therefore, since the junction force of the aforementioned protective-group board and the 2nd protective coat of the above becomes powerful, when a magnetic tape slides on the aforementioned tape opposed face top, it is avoided that the aforementioned protective-group board is damaged in an interface with the 2nd protective coat of the above.
[0045] In addition, as the aforementioned thin film magnetic head formed in the process of the above (b) or the above (j), only MR type thin film magnetic head for reproduction may be formed, and the compound-die thin film magnetic head by which the laminating of the inductive magnetic head for record was carried out to the upper layer of MR type thin film magnetic head for reproduction may be formed.
[0046] Moreover, as for the substrate used as the aforementioned protective-group board used at the process of the above (f) or the above (n), it is desirable to be formed with the non-magnetic material of the stiff quality of the materials, such as for example, an alumina titanium carbide, titanium calcium, and a calcium ferrite.
[0047] Moreover, in the process of the above (c), (k), or (n), the aforementioned protective coat or the 1st protective coat of the above, and the 2nd protective coat of the above can be formed by aluminum 2O3 or SiO2.
[0048] Furthermore, in the process of the above (h) or (q), it is desirable to paste up with the epoxy system adhesives or low-melting-glass system adhesives which can perform an adhesion process at the temperature of 300 degrees C or less to which the property of MR type thin film magnetic head does not deteriorate the aforementioned protective coat, the aforementioned protective-group board, or the 1st protective coat of the above and the 2nd protective coat of the above.
[0049]
[Embodiments of the Invention] Drawing 1 is the perspective diagram of the slid type thin film magnetic head showing the gestalt of operation of this invention.
[0050] This slid type thin film magnetic head H3 minds the ground layer which consists of insulating material, such as aluminum 2O3 and SiO2, on the substrate 21 which consists of an alumina titanium carbide. The insulating layer 24 which consists of MR type thin film magnetic head 22 for reproduction, an inductive head 23 for record, and aluminum 2O3 that is a protective coat is formed of a thin film formation process. It is formed by joining the protective-group board 26 which consists of an alumina titanium carbide through the glue line 25 which consists of epoxy system adhesives on an insulating layer 24.
[0051] The glue line 25 is not exposed to tape opposed face H3A. Or even if it has exposed, the exposed-surface product is few. Moreover, the thickness of the tape run direction (the direction of X) of a glue line 25 is thick as the other distance becomes large in the height direction (the direction of Y) from tape opposed face H3A. Therefore, in this slid type thin film magnetic head H3, adhesion with an insulating layer 24 and the

protective-group board 26 is made in the part mainly separated from tape opposed face H3A to the height side.
[0052] Therefore, in case a magnetic tape slides on tape opposed face H3A, it can prevent that a magnetic powder adheres to tape opposed face H3A, or can suppress, and the magnetic-recording property of a magnetic tape can be raised.
[0053] Moreover, let the plane of composition with the glue line 25 of an insulating layer 24, and the plane of composition with the glue line 25 of the protective-group board 26 be the inclined planes to a flat surface perpendicular to the tape run direction (the direction of X) in the slid type thin film magnetic head H3 of the gestalt of this operation. That is, the thickness of the tape run direction of a glue line 25 is made to be increased continuously until it results in back end side 26A of the protective-group board 26 toward the height direction (the direction of Y) with tape opposed face H3A as the starting point.
[0054] The magnetic gap of MR type thin film magnetic head 22 and the magnetic gap of an inductive head 23 are exposed to tape opposed face H3A of the slid type thin film magnetic head H3. The current passed by MR type thin film magnetic head 22 and the inductive head 23 is given through an electrode 27.
[0055] Drawing 2 is the fragmentary sectional view of the MR type thin film magnetic-head [of the slid type thin film magnetic head H3 of drawing 1] 22, and inductive head 23 circumference.
[0056] Through insulating-layer 22a which is a ground layer, the laminating of lower shield layer 22b, lower gap layer 22c, 22d [of MR element layers], hard bias layer (not shown), and electrode layer 22e, 22f of up gap layers, and the 22g of the up shield layers is carried out by the thin film formation process, and MR type thin film magnetic head 22 for reproduction is formed in the substrate 21 which consists of an alumina titanium carbide of it. The portion which counters the magnetic tape inserted into lower shield layer 22b and 22g of up shield layers serves as magnetic-gap G3 of MR type thin film magnetic head 22.
[0057] Like MR type thin film magnetic head 22, on lower core layer 23a of an up shield layer and combination, the laminating of gap layer 23b, coil layer 23c, 23d of insulating layers, and the up core layer 23e is carried out by the thin film formation process, and the inductive head 23 for record formed on MR type thin film magnetic head 22 is formed of it. The portion which counters the magnetic tape inserted into lower core layer 23a and up core layer 23e serves as the magnetic gap G4 of an inductive head 23.
[0058] Insulating-layer 22a, lower gap layer 22c, 22f of up gap layers, and gap layer 23b are formed of aluminum 2O3 or SiO2. Moreover, lower shield layer 22b, 22g (lower core layer 23a) of up shield layers, and up core layer 23e are formed of soft magnetic materials, such as a permalloy. Electrode layer 22e and coil layer 23c are formed of conductive material, such as Cu. The hard bias layer is formed of hard magnetic materials, such as PtCo. 23d of insulating layers is formed of the resist.
[0059] Moreover, on the inductive head 23, the laminating of the insulating layer 24 which is a protective coat is carried out, and the insulating layer 24 and the protective-group board 26 are joined through the glue line 25 which consists of epoxy system adhesives.
[0060] The thickness of the tape run direction (the direction of X) in tape opposed face H3A of a glue line 25 is 0 in tape opposed face H3A, and it is thick as the other distance becomes large in the height direction (the direction of Y) from tape opposed face H3A.
[0061] In addition, there is no bird clapper more narrowly than the area of a plane of composition with the glue line 15 of the insulating layer 14 of the conventional slid type thin film magnetic head the area of a plane of composition with the glue line 25 of an insulating layer 24 and a plane of composition with the glue line 25 of the protective-group board 26 was indicated to be to drawing 16 with the gestalt of this operation, and a plane of composition with the glue line 15 of the protective-group board 16.
[0062] Therefore, the junction force of the insulating layer 24 and the protective-group board 26 through the glue line 25 does not decline compared with the conventional slid type thin film magnetic head.
[0063] In addition, although the plane of composition with the glue line 25 of an insulating layer 24 and the plane of composition with the glue line 25 of the protective-group board 26 are made into the inclined plane to a flat surface perpendicular to the tape run direction with the gestalt of this operation, let only one of planes of composition be inclined planes.
[0064] Since the rotary-head equipment 40 formed in the magnetic recorder and reproducing device shown in drawing 3 is constituted, the slid type thin film magnetic head H3 of the gestalt of this operation can be used.
[0065] With rotary-head equipment 40, a fixed drum (not shown) is fixed, rotating-drum 40a of this and the same axle is supported by the aforementioned fixed drum lifting free [rotation], and the rotation drive of the rotating-drum 40a is carried out in the direction of an arrow by the power of a motor. Magnetic tape T which is a magnetic-recording medium is twisted around rotary-head equipment 40 the degree of predetermined angle by helical tracing, and runs in the direction of an arrow. In the meantime, rotating-drum 40a rotates and the magnetic head H3 carried in this rotating-drum 40a scans magnetic tape T. With the rotary-head equipment of drawing 3 , 1 set of magnetic heads H3 and H3 are formed in the position which counters mutually.
[0066] In addition, the three or more magnetic heads H3 may be carried in rotating-drum 40a.
[0067] Drawing 4 is the perspective diagram of the slid type thin film magnetic head showing the gestalt of other operations of this invention. In drawing 4 , the insulating layer 34 which consists of aluminum 2O3 which is MR type thin film magnetic head 32 for reproduction, the inductive head 33 for record, and the 1st protective coat is formed of the thin film formation process on the substrate 31 which consists of an alumina titanium carbide through the ground layer which consists of insulating material, such as aluminum 2O3 and SiO2. Thin film formation of the insulating layer 36 which is the 2nd protective coat is carried out by the vacuum forming-membranes methods, such as a spatter, in the field which, on the other hand, counters the insulating layer 34 of the protective-group board 35 which consists of an alumina titanium carbide.
[0068] The slid type thin film magnetic head H4 is formed by joining an insulating layer 34 and an insulating layer 36 through the glue line 37 which consists of epoxy system adhesives.
[0069] The glue line 37 is not exposed to tape opposed face H4A. Or exposed-surface products are few. Moreover, the thickness of the tape run direction (the direction of X) of a glue line 37 is thick as the other distance becomes large in the height direction (the direction of Y) from tape opposed face H4A.
[0070] Therefore, in case a magnetic tape slides on tape opposed face H4A, it can prevent that a magnetic powder adheres to tape opposed face H4A, and the magnetic-recording property of a magnetic tape can be raised.
[0071] Moreover, also by the slid type thin film magnetic head H4 of the gestalt of this operation, the thickness of the tape run direction of a glue line 37 is made to be increased continuously until it results in back end side 35A of the protective-group board 35 toward the height direction (the direction of Y) with tape opposed face H4A as the starting point.
[0072] The magnetic gap of MR type thin film magnetic head 32 and the magnetic gap of an inductive head 33 are exposed to tape opposed face H4A of the slid type thin film magnetic head H4. The current passed by MR type thin film magnetic head 32 and the inductive head 33 is passed through an electrode 38.
[0073] Drawing 5 is the fragmentary sectional view of the MR type thin film magnetic-head [of the slid type thin film magnetic head H4 of drawing 4] 32, and inductive head 33 circumference.
[0074] Through insulating-layer 32a which is a ground layer, the laminating of lower shield layer 32b, lower gap layer 32c, 32d [of MR element layers], hard bias layer (not shown), and electrode layer 32e, 32f of up gap layers, and the 32g of the up shield layers is carried out by the thin film formation process, and MR type thin film magnetic head 32 for reproduction is formed in the substrate 31 which consists of an alumina

titanium carbide of it. The portion which counters the magnetic tape inserted into lower shield layer 32b and 32g of up shield layers serves as the magnetic gap G5 of MR type thin film magnetic head 32.
[0075] Like MR type thin film magnetic head 32, on lower core layer 33a of an up shield layer and combination, the laminating of gap layer 33b, coil layer 33c, 33d of insulating layers, and the up core layer 33e is carried out by the thin film formation process, and the inductive head 33 for record formed on MR type thin film magnetic head 32 is formed of it. The portion which counters the magnetic tape inserted into lower core layer 33a and up core layer 33e serves as the magnetic gap G6 of an inductive head 33.
[0076] Insulating-layer 32a, lower gap layer 32c, 32f of up gap layers, and gap layer 33b are formed of aluminum 2O3 or SiO2. Moreover, lower shield layer 32b, 32g (lower core layer 33a) of up shield layers, and up core layer 33e are formed of soft magnetic materials, such as a permalloy. Electrode layer 32e and coil layer 33c are formed of conductive material, such as Cu. The hard bias layer is formed of hard magnetic materials, such as PtCo. 33d of insulating layers is formed of the resist.
[0077] The thickness of the tape run direction (the direction of X) in tape opposed face H4A of a glue line 37 is 0 in tape opposed face H4A, and it is thick as the other distance becomes large in the height direction (the direction of Y) from tape opposed face H4A.
[0078] Therefore, in case a magnetic tape slides on the tape opposed face of the magnetic head, it can prevent that a magnetic powder adheres to a tape opposed face, and the magnetic-recording property of a magnetic tape can be raised.
[0079] If the glue line 37 is directly joined to the protective-group board 35, when a magnetic tape will slide on tape opposed face H4A, the protective-group board 35 may be damaged in an interface with a glue line 37. When especially the protective-group board 35 is formed like the alumina titanium carbide of the material which degraining of crystal grain tends to produce, the protective-group board 35 tends to degrain in an interface with a glue line 37. Since it generates when intermolecular force (Van der Waals force) mainly works between the molecule which constitutes a glue line, and the molecule which constitutes the protective-group board 37, the junction force when a glue line 37 and the protective-group board 35 are joined is because sufficient bonding strength cannot be obtained.
[0080] Then, thin film formation of the insulating layer 36 which is the 2nd protective coat which consists of insulating material, such as aluminum 2O3, is carried out by the spatter etc., and a glue line 37 is joined to an insulating layer 36 by the field which counters the glue line 37 of the protective-group board 35.
[0081] In a spatter, the material atom of an insulating layer 36 with the energy beyond a fixed level, for example, energy 10eV or more, is driven in on the protective-group board 35. At this time, covalent bond of the material atom of an insulating layer 36 and the composition atom of the protective-group board 35 can be carried out. Therefore, since the junction force of the protective-group board 35 and an insulating layer 36 becomes powerful, when a magnetic tape slides on tape opposed face H4A, it is avoided in the interface of the protective-group board 35 and an insulating layer 36 that the protective-group board 35 is damaged.
[0082] In addition, there is no bird clapper more narrowly than the area of a plane of composition with the glue line 15 of the insulating layer 14 of the conventional slid type thin film magnetic head the area of a plane of composition with the glue line 37 of an insulating layer 34 and a plane of composition with the glue line 37 of an insulating layer 36 was indicated to be to drawing 16 also with the form of this operation, and a plane of composition with the glue line 15 of the protective-group board 16.
[0083] Therefore, the junction force of the insulating layer 34 and insulating layer 36 through the glue line 37 does not decline compared with the conventional slid type thin film magnetic head.
[0084] The slid type thin film magnetic head H4 of the form of this operation can be used as an equivalent device of the slid type thin film magnetic head H3 of the rotary-head equipment 40 formed in a magnetic recorder and reproducing device as shown in drawing 3 .
[0085] In addition, although the plane of composition with the glue line 37 of an insulating layer 34 and the plane of composition with the glue line 37 of an insulating layer 36 are made into the inclined plane to a flat surface perpendicular to the tape run direction, only one of planes of composition are not cared about with the form of this operation as an inclined plane.
[0086] Moreover, the form of operation of this invention shown in drawing 1 , drawing 2 , drawing 4 , and drawing 5 is the compound-die thin film magnetic head by which the laminating of the inductive head for record was carried out to the upper layer of MR type thin film magnetic head for reproduction. If it is the compound-die thin film magnetic head, the one magnetic head can perform record and reproduction. Moreover, since an inductive head is formed of thin film formation processes, such as resist photo lithography, it is easy to raise the process tolerance of a magnetic gap, and ** truck-ization becomes easy.
[0087] Moreover, when a magnetic tape runs a tape opposed face H3A [of the slid type thin film magnetic heads H3 and H4], and H4A top, the protective-group boards 26 and 35 are formed in order to prevent wearing out superfluously MR type thin film magnetic heads 22 and 32 and inductive heads 23 and 33 or damaging. There are titanium calcium, a calcium ferrite, etc. as non-magnetic materials other than the alumina titanium carbide suitable for the purpose which forms the protective-group boards 26 and 35.
[0088] Moreover, you may use SiO2 in addition to aluminum2O3 as an insulating material which forms the insulating layers 24, 34, and 36 which are protective coats.
[0089] Furthermore, since glue lines 25 and 37 are formed with epoxy system adhesives, they can perform an adhesion process below 300 degrees C, and do not reduce the property of MR type thin film magnetic head. In addition, glue lines 25 and 37 may be formed by low-melting-glass system adhesives instead of epoxy system adhesives.
[0090] Drawing 6 to drawing 10 is a perspective diagram for explaining the manufacture method of the slid type thin film magnetic head of the gestalt operation of this invention shown in drawing 1 or drawing 2 .
[0091] First, thin film formation of the ground layer which consists of insulating material, such as aluminum 2O3 and SiO2, on the substrate 21 which consists of an alumina titanium carbide is carried out by the spatter. Next, thin film formation of MR type thin film magnetic head 22 and the inductive head 23 is carried out one by one on this ground layer. After an inductive head 23 is formed, thin film formation of the insulating layer 24 which is the protective coat which consists of aluminum 2O3 is carried out by the spatter. Drawing 6 shows signs that the laminating of the insulating layer 24 was carried out on MR type thin film magnetic head 22 (not shown in drawing 6), and the inductive head 23 (not shown in drawing 6). In addition, when forming MR type thin film magnetic head 22 and an inductive head 23, an electrode 27 is also formed by plating of conductive material, such as Cu.
[0092] In drawing 6 , MR type thin film magnetic head 22 (not shown in drawing 6), an inductive head 23 (not shown in drawing 6), and an electrode 27 set a fixed interval, and are formed in the substrate top whole surface (only the part is illustrated to drawing 6).
[0093] A dotted line cuts the substrate 21 of a circle configuration, and it is made a slider bar like drawing 7 .
[0094] Furthermore, on an insulating layer 24, from tape opposed face 24A, slot 24a which becomes deep is formed as the distance from tape opposed face 24A becomes large. Like drawing 7 , when the electrode 27 is formed on the insulating layer 24, slot 24a is formed so that an electrode 27 may not be started.
[0095] A dotted line cuts the protective-group board 26 which consists of an alumina titanium carbide shown in drawing 8 on the other hand, and it is made a slider bar.
[0096] The end side of the protective-group board 26 cut by the slider bar is ground, and inclined plane 26a is formed like drawing 9 .
[0097] furthermore, the epoxy system adhesives which inclined plane 26a and slot 24b are made to counter like drawing 10 , and serve as a

glue line 25 in the protective-group board 26 with which inclined plane 26a was formed, and the substrate 21 in which slot 24b was formed — the protective-group board 26, a substrate 21, and an insulating layer 24 — it pastes up so that each tape opposed face 26B, 21A, and 24A may turn into a flat side Moreover, at this time, adhesion fixation is carried out so that adhesives may not be exposed to a tape opposed face.
[0098] In addition, it is only available for inclined plane 26a of the protective-group board 26, and slot 24b of an insulating layer 24 that it is not necessary to necessarily form both and only either is formed.
[0099] Furthermore, cylindrical grinding or by carrying out copy grinding, a tape opposed face is processed into R configuration, is cut by the dotted line, and becomes each slid type thin film magnetic head H3 as shown in drawing 1 .
[0100] Moreover, by the manufacture method of the thin film magnetic head H4 shown in drawing 4 and drawing 5 , thin film formation of the ground layer which consists of insulating material, such as aluminum 2O3 and SiO2, first on the substrate 31 of the circle configuration which consists of an alumina titanium carbide is carried out by the spatter. Next, thin film formation of MR type thin film magnetic head 32 and the inductive head 33 is carried out one by one on this ground layer. After an inductive head 33 is formed, thin film formation of the insulating layer 34 which is the 1st protective coat which consists of aluminum 2O3 is carried out by the spatter.
[0101] In addition, when forming MR type thin film magnetic head and an inductive head, an electrode 38 is also formed by plating of conductive material, such as Cu.
[0102] A fixed interval is set and two or more MR type thin film magnetic heads 32, inductive heads 33, and electrodes 38 are formed in the substrate top whole surface of the circle configuration of one sheet.
[0103] The substrate 31 of a circle configuration is cut and it is made a slider bar. Furthermore, on an insulating layer 34, from a tape opposed face, the slot which becomes deep is formed as the distance from this tape opposed face becomes large. When the electrode 38 is formed on the insulating layer 34, a slot is formed so that an electrode 38 may not be started.
[0104] It is the same as the process explained so far, using drawing 6 and drawing 7 as the manufacture method of the slid type thin film magnetic head of drawing 1 and drawing 2 which carried out point **.
[0105] By the manufacture method of drawing 4 and the slid type thin film magnetic head H4 of drawing 5 , thin film formation of the insulating layer 36 which is the 2nd protective coat which consists of aluminum 2O3 like drawing 11 on the protective-group board 35 which consists of an alumina titanium carbide is carried out by the spatter etc.
[0106] An insulating layer 36 cuts the protective-group board 35 by which the laminating was carried out along with the dotted line of drawing 11 , and uses it as a slider bar. The insulating layer 36 of this slider bar is ground, and inclined plane 36a is formed like drawing 13 .
[0107] furthermore, the epoxy system adhesives which inclined plane 36a and slot 34a are made to counter like drawing 12 , and serve as a glue line 37 in the protective-group board 35 with which inclined plane 36a was formed, and the substrate 31 in which slot 34a was formed — the protective-group board 35, an insulating layer 36, a substrate 31, and an insulating layer 34 — it pastes up so that each tape opposed face 35B, 36A, 31A, and 34A may turn into a flat side Moreover, at this time, adhesion fixation is carried out so that adhesives may not be exposed to a tape opposed face.
[0108] In addition, it is only available for inclined plane 36a of an insulating layer 36, and slot 34a of an insulating layer 34 that it is not necessary to necessarily form both and only either is formed.
[0109] Furthermore, cylindrical grinding or by carrying out copy grinding, a tape opposed face is processed into R configuration, is cut by the dotted line, and becomes each slid type thin film magnetic head H4 as shown in drawing 4 .
[0110] Thus, in case according to the manufacture method of the slid type thin film magnetic head of this invention a glue line is not exposed to a tape opposed face and a magnetic tape slides on the tape opposed face of the magnetic head, it can prevent that a magnetic powder adheres to the aforementioned tape opposed face, and the slid type thin film magnetic head which can raise the magnetic-recording property of a magnetic tape can be formed.
[0111] In addition, the substrate 21, the protective-group board 26, the substrate 31, and the protective-group board 35 may be formed of titanium calcium, the calcium ferrite, etc. Moreover, the insulating layer 24, the insulating layer 34, and the insulating layer 36 may be formed of SiO2.
[0112] Moreover, you may use low-melting-glass system adhesives for the adhesives which join the protective-group board 26 to an insulating layer 24, and the adhesives which join an insulating layer 34 and an insulating layer 36.
[0113] Thus, since the slid type thin film magnetic heads H3 and H4 of the gestalt of this operation are formed of a thin film formation process, they can be mass-produced at once and are easy to miniaturize. Moreover, even when setting the width of recording track to 10 micrometers or less, the process tolerance of a magnetic gap can be raised as required.
[0114]
[Effect of the Invention] In case according to this invention explained to the detail above a glue line is not exposed to a tape opposed face and a magnetic tape slides on the tape opposed face of the magnetic head, it can prevent that a magnetic powder adheres to the aforementioned tape opposed face, and the slid type thin film magnetic head which can raise the magnetic-recording property of a magnetic tape can be formed.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective diagram of the slid type thin film magnetic head showing the gestalt of operation of this invention.
[Drawing 2] It is the fragmentary sectional view of DDO to the slid type thin film MAG of drawing 1 .
[Drawing 3] The plan of the rotary-head type magnetic recorder and reproducing device constituted using the slid type thin film magnetic head of drawing 1 .
[Drawing 4] The perspective diagram of the slid type thin film magnetic head showing the gestalt of other operations of this invention.
[Drawing 5] The fragmentary sectional view of the slid type thin film magnetic head of drawing 4 .
[Drawing 6] The perspective diagram showing the state in the manufacture method of the slid type thin film magnetic head of this invention where the laminating of MR type thin film magnetic head, an inductive head, and the insulating layer that is a protective coat was carried out on the substrate.
[Drawing 7] The perspective diagram showing the state where the substrate of drawing 6 was cut by the dotted line and used as the slider bar.
[Drawing 8] The perspective diagram showing the substrate used as a protective-group board.
[Drawing 9] The perspective diagram showing the state where the substrate of drawing 8 was cut by the dotted line, considered as the slider bar, and the inclined plane was formed.
[Drawing 10] The perspective diagram showing the state where the slider bar of drawing 7 and the slider bar of drawing 9 were joined.
[Drawing 11] The perspective diagram showing the state where thin film formation of the insulating layer was carried out on the substrate used as a protective-group board.
[Drawing 12] The perspective diagram showing the state where the substrate of drawing 11 was cut by the dotted line, considered as the slider bar, and the inclined plane was formed.
[Drawing 13] The perspective diagram showing the state where MR type thin film magnetic head, the inductive head, and the slider bar and the slider bar of drawing 12 with which the laminating of the insulating layer which is the 1st protective coat was carried out were joined.
[Drawing 14] The perspective diagram of the conventional magnetic head.
[Drawing 15] The plan of a rotary-head type magnetic recorder and reproducing device.
[Drawing 16] The perspective diagram of the conventional slid type thin film magnetic head.
[Drawing 17] The fragmentary sectional view of the slid type thin film magnetic head of drawing 16 .
[Description of Notations]
21 31 Substrate
22 32 MR type thin film magnetic head
23 33 Inductive head
24, 34, 36 Insulating layer
26 35 Protective-group board
25 37 Glue line
28 38 Electrode

[Translation done.]

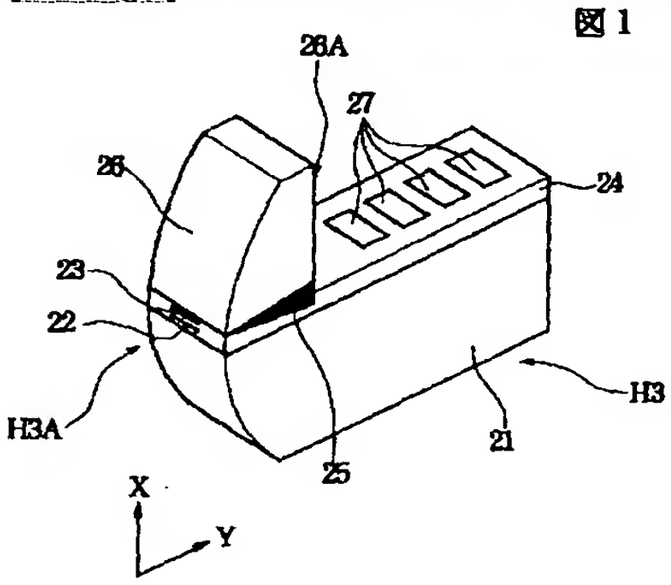
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

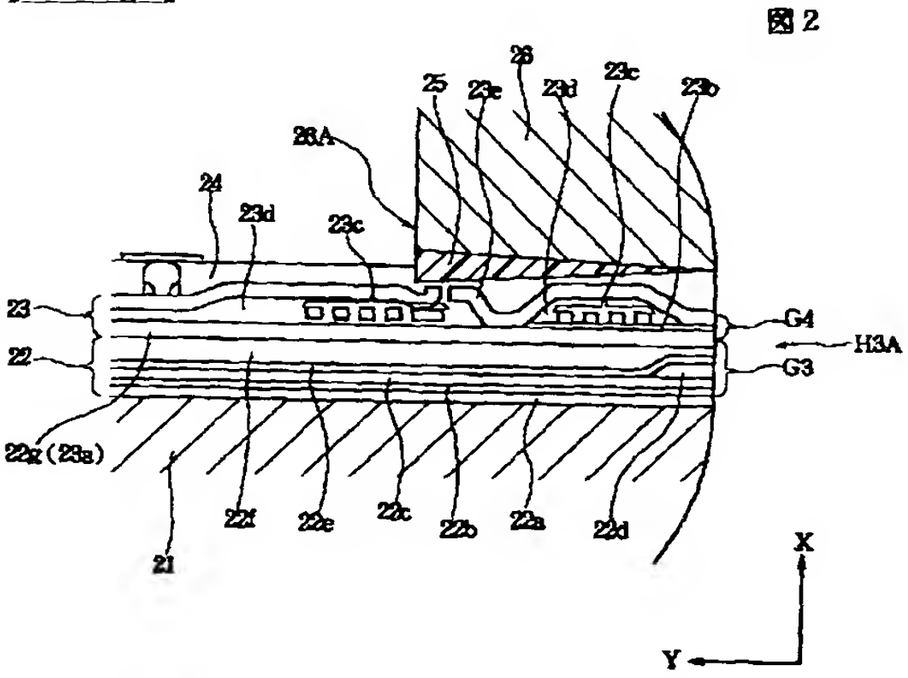
[Drawing 1]

図 1



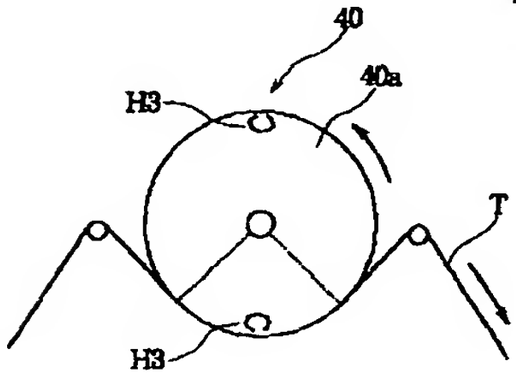
[Drawing 2]

図 2



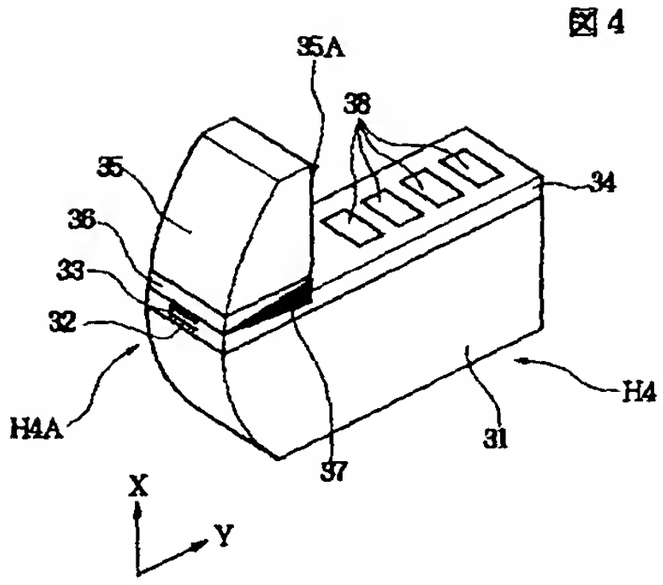
[Drawing 3]

図 3



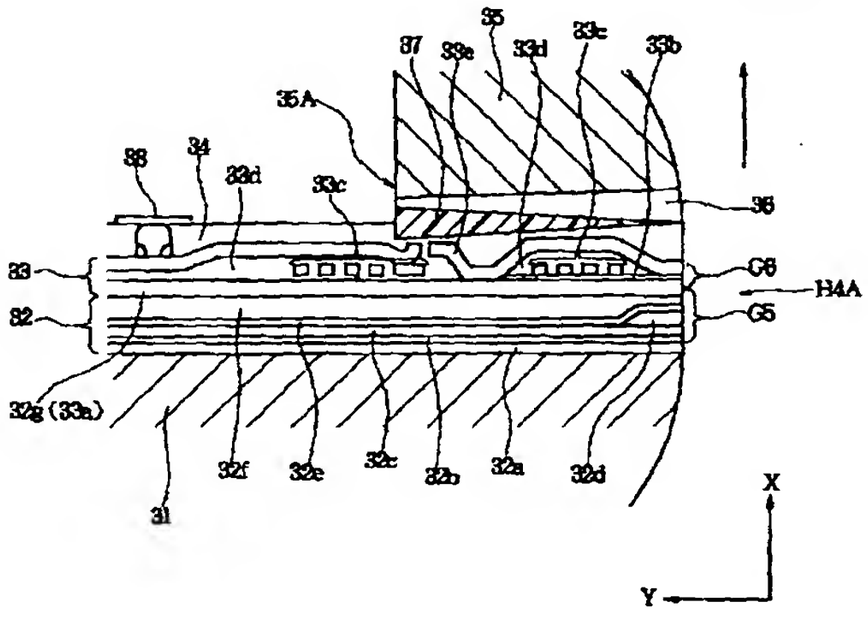
[Drawing 4]

図 4



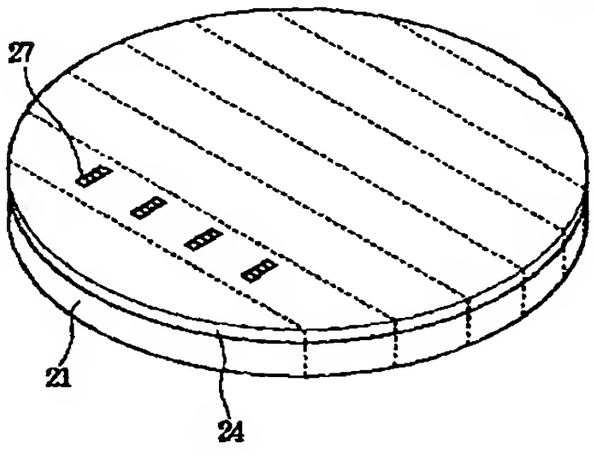
[Drawing 5]

図 5



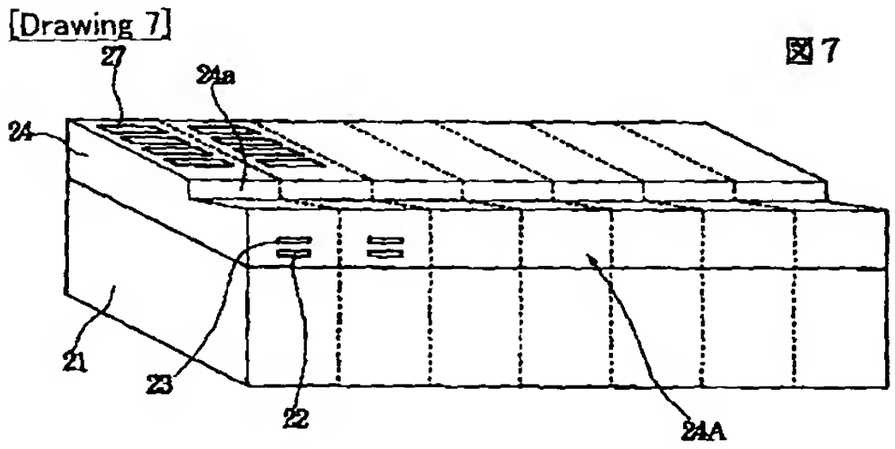
[Drawing 6]

図 6



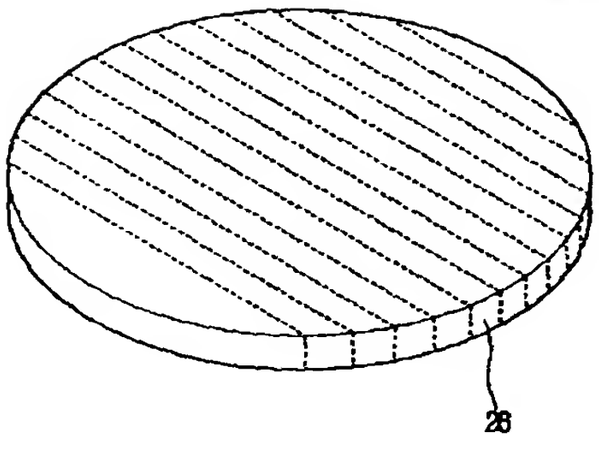
[Drawing 7]

図 7



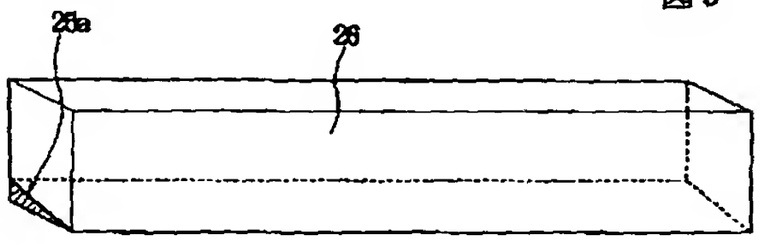
[Drawing 8]

図 8



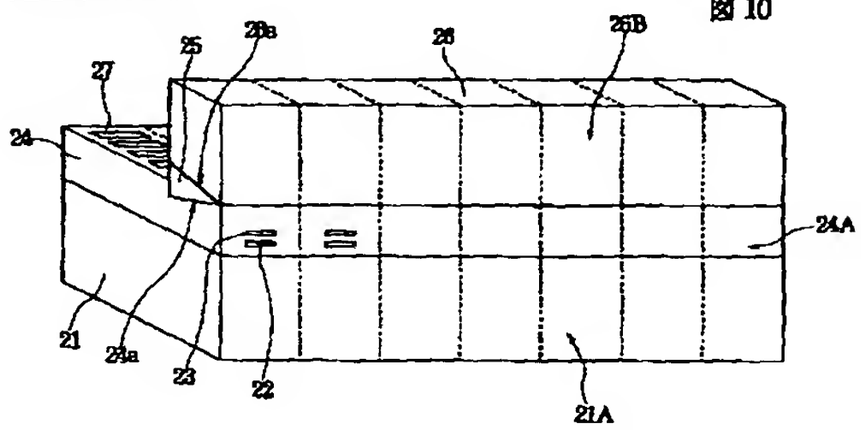
[Drawing 9]

図 9



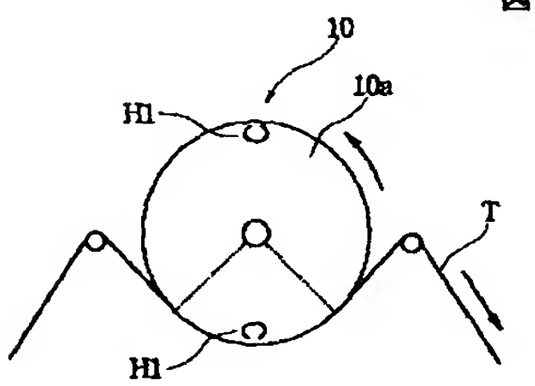
[Drawing 10]

図 10



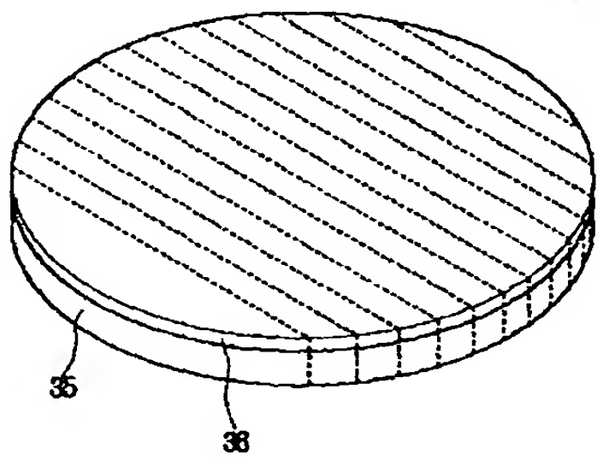
[Drawing 15]

図 15



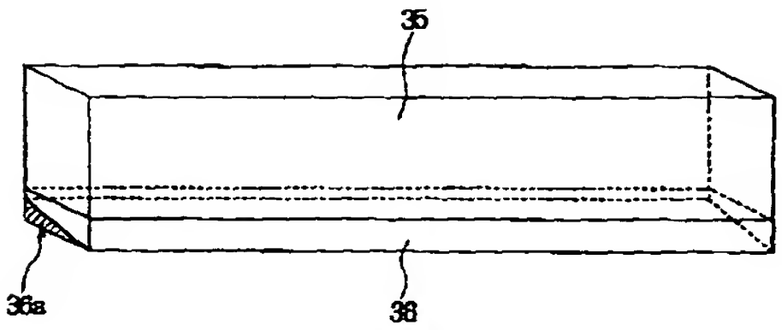
[Drawing 11]

図 11



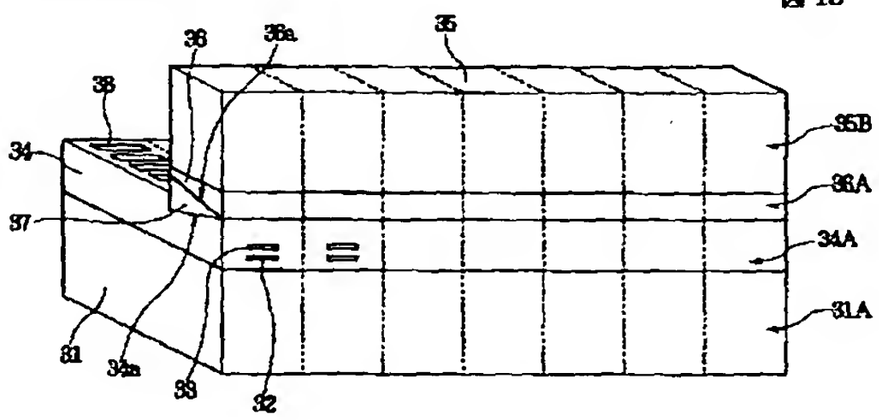
[Drawing 12]

図 12



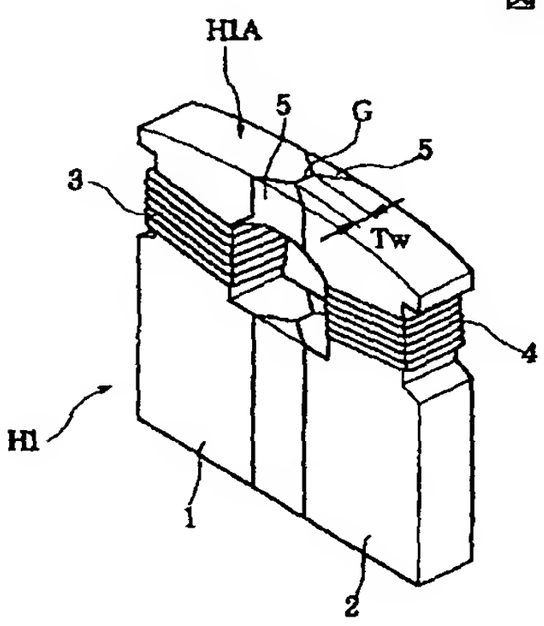
[Drawing 13]

図 13



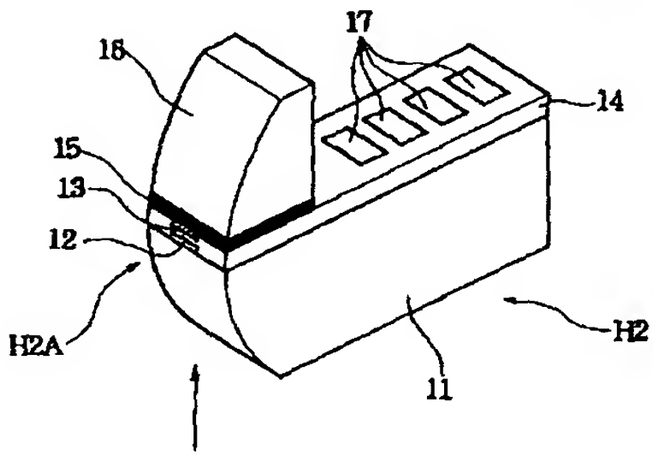
[Drawing 14]

図 14



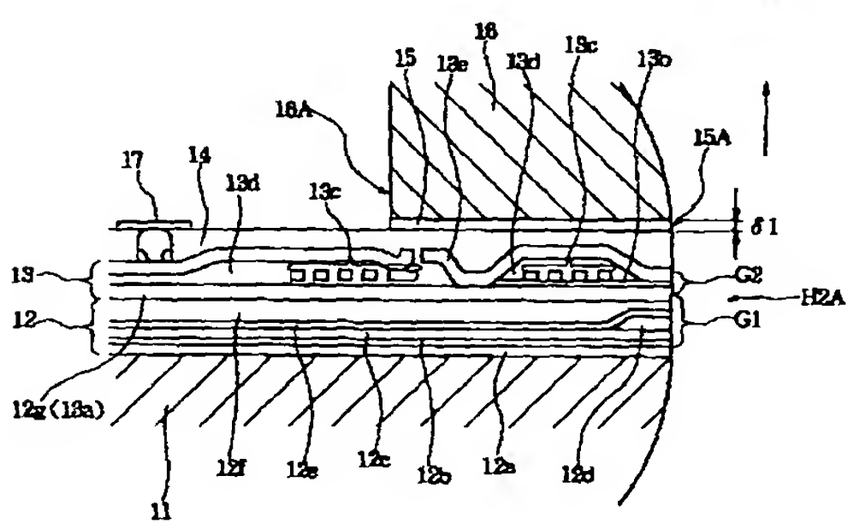
[Drawing 16]

図 16



[Drawing 17]

図 17



[Translation done.]

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
[Section partition] The 4th partition of the 6th section.
[Date of issue] February 14, Heisei 15 (2003. 2.14)

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[**** format] Open patent official report 12-3574.
[Filing Number] Japanese Patent Application No. 11-166527.
[The 7th edition of International Patent Classification]

G11B 5/127 .
5/31 .
5/39 .

[FI]

G11B 5/127 W .
5/31 H .
5/39 .

[Procedure revision]
[Filing Date] November 13, Heisei 14 (2002. 11.13)
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] The ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, It has the protective-group board formed with the thin film magnetic head, the protective coat which consists of an insulating material and the magnetic material, or the non-magnetic material. In the slid type thin film magnetic head by which the magnetic gap of the aforementioned thin film magnetic head is exposed to the tape opposed face of the aforementioned magnetic head It is the slid type thin film magnetic head to which the aforementioned protective coat is joined to the aforementioned protective-group board through the glue line, and this glue line is characterized by forming the direction of the back side of the height direction thickly rather than the aforementioned tape opposed face side.
[Claim 2] It has the following and the 1st protective coat of the above and the 2nd protective coat of the above are joined through the glue line. this glue line It is characterized by forming the back side of the height direction thickly rather than the aforementioned tape opposed face side.
The ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material, The slid type thin film magnetic head by which it has the protective-group board formed with the thin film magnetic head, the protective coat which consists of an insulating material and the magnetic material, or the non-magnetic material, and the magnetic gap of the thin film magnetic head is exposed to the tape opposed face of the aforementioned magnetic head. The aforementioned protective coat is the 1st protective coat by which thin film formation was carried out on the aforementioned thin film magnetic head formed on the aforementioned substrate. The 2nd protective coat by which thin film formation was carried out at the aforementioned protective-group board.
[Claim 3] The aforementioned glue line is the slid type thin film magnetic head according to claim 1 or 2 which has not appeared in a tape opposed face.
[Claim 4] The thickness of the aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 3 which increases continuously until it reaches the back end side of the aforementioned protective-group board toward the height direction with a tape opposed face as the starting point.
[Claim 5] The thickness of the aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 3 which becomes thick gradually until it reaches the back end side of the aforementioned protective-group board toward the height direction with a tape opposed face as the starting point.
[Claim 6] The thickness of the aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 3 which once becomes thick toward the height direction with a tape opposed face as the starting point, becomes thin toward the height direction after that, and reaches the back end side of the aforementioned protective-group board.
[Claim 7] The slid type thin film magnetic head according to claim 1 to 6 whose aforementioned thin film magnetic head is MR type thin film magnetic head.
[Claim 8] The slid type thin film magnetic head according to claim 1 to 6 whose aforementioned thin film magnetic head is the compound-die thin film magnetic head of MR type thin film magnetic head and the inductive magnetic head.
[Claim 9] The slid type thin film magnetic head according to claim 1 to 8 in which the aforementioned protective-group board is formed with

non-magnetic materials, such as an alumina titanium carbide, titanium calcium, and a calcium ferrite.
[Claim 10] The aforementioned protective coat is the slid type thin film magnetic head according to claim 1 to 9 currently formed of aluminum 2O3 or SiO2.
[Claim 11] The aforementioned glue line is the slid type thin film magnetic head according to claim 1 to 10 currently formed by epoxy system adhesives or low-melting-glass system adhesives.
[Claim 12] (a) The process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material,
(b) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer,
(c) The process which carries out thin film formation of the protective coat which consists of an insulating material on the aforementioned thin film magnetic head,
(d) The process which cuts the aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the protective coat was formed, and is used as a slider bar,
(e) The process which forms the slot which becomes deep on the aforementioned protective coat of the aforementioned slider bar as it separates from the aforementioned tape opposed face,
(f) The process which cuts the substrate used as a protective-group board, and is used as a slider bar,
(g) The process which grinds the end side of the aforementioned slider bar and forms an inclined plane,
(h) The manufacture method of the slid type thin film magnetic head characterized by having the process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the slot was formed on the protective coat of the process of the above (e), and the slider bar with which the inclined plane was formed of the process of the above (g) with adhesives.
[Claim 13] (i) Process which carries out thin film formation of the ground layer which consists of an insulating material on the substrate formed with the magnetic material or the non-magnetic material,
(j) The process which carries out thin film formation of the thin film magnetic head on the aforementioned ground layer,
(k) The process which carries out thin film formation of the 1st protective coat which consists of an insulating material on the aforementioned thin film magnetic head by the vacuum forming-membranes method,
(l) The process which cuts the aforementioned ground layer, the aforementioned thin film magnetic head, and the substrate in which the 1st protective coat was formed, and is used as a slider bar,
(m) The process which forms the slot which becomes deep on the aforementioned protective coat of the aforementioned slider bar as it separates from the aforementioned tape opposed face,
(n) The process which carries out thin film formation of the 2nd protective coat by the vacuum forming-membranes method on the substrate used as a protective-group board,
(o) The process which cuts the substrate in which the 2nd protective coat of the above was formed, and is used as a slider bar,
(p) The process which grinds the 2nd protective coat of the above and forms an inclined plane,
(q) The process which the aforementioned slot and the aforementioned inclined plane are made to counter, and carries out adhesion fixation of the slider bar with which the slot was formed on the protective coat of the process of the above (m), and the slider bar with which the inclined plane was formed of the process of the above (p) with adhesives,
The manufacture method of the slid type thin film magnetic head characterized by ****(ing).
[Claim 14] The manufacture method of the slid type thin film magnetic head according to claim 12 or 13 that the aforementioned thin film magnetic head formed in the process of the above (b) or the above (j) is MR type thin film magnetic head.
[Claim 15] The manufacture method of the slid type thin film magnetic head according to claim 12 or 13 that the aforementioned thin film magnetic head formed in the process of the above (b) or the above (j) is the compound-die thin film magnetic head of MR type thin film magnetic head and the inductive magnetic head.
[Claim 16] The manufacture method of the slid type thin film magnetic head according to claim 12 to 15 that the substrate used as the aforementioned protective-group board used at the process of the above (f) or the above (n) is formed with non-magnetic materials, such as an alumina titanium carbide, titanium calcium, and a calcium ferrite.
[Claim 17] The manufacture method of the slid type thin film magnetic head according to claim 12 to 16 which forms the aforementioned protective coat or the 1st protective coat of the above, and the 2nd protective coat of the above by aluminum 2O3 or SiO2 in the process of the above (c), (k), or (n).
[Claim 18] The manufacture method of the slid type thin film magnetic head according to claim 12 to 17 of pasting up the aforementioned protective coat, the aforementioned protective-group board, or the 1st protective coat of the above and the 2nd protective coat of the above with epoxy system adhesives or low-melting-glass system adhesives in the process of the above (h) or (q).

[Translation done.]